# MECHANICS' MAGAZINE,

AND

# REGISTER OF INVENTIONS AND IMPROVEMENTS.

VOLUME V.] JUNE, 1835. [NUMBER 6.


## SEABURY AND YOUNG'S IMPROVED PATENT BARK MILL.

Fig. 1.

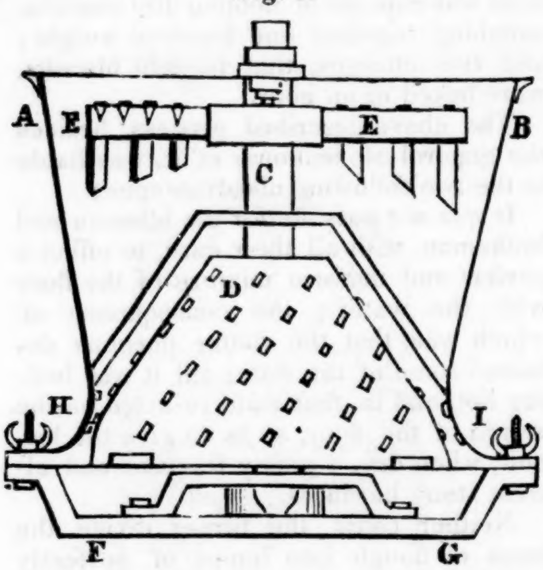
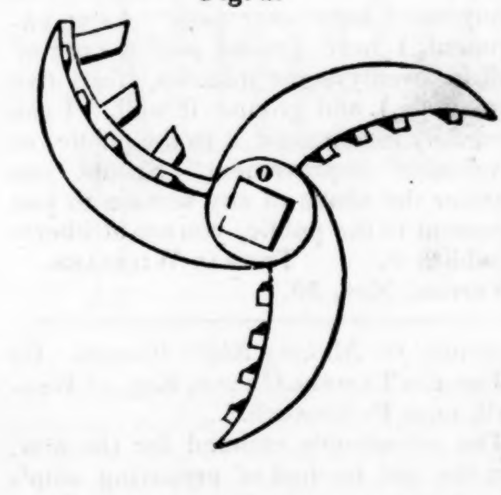



Fig. 2.




We have received, from Messrs. Seabury and Young a drawing and concise description of their Bark Mill, to which we referred on the cover of the April number. They furnished us with drawings of the different parts, two only of which we have had engraved: one, a cross section, showing the interior of the mill; and the other the apparatus for cracking the bark as it passes in, to the mill.

We have never seen one of them in operation, but are induced to believe that it will be found a first rate machine, not only for the purpose for which it is designed, but also, if made a little finer, for grinding apples, and for breaking corn on the cob for cattle, or preparatory to its being ground into meal.

One of the mills, addressed to Gibert & Son, New-Haven, was some time since left in front of our office, and has attracted much attention, but we are unable to answer the numerous questions put relative to its cost, &c. and would suggest to the patentees the propriety of furnishing the necessary information.

Fig. 1 represents a cross section of the mill when in position for use. A B, the pot; D, the nut or cone, with numerous projections on its surface, which revolves within the pot; C, the upright shaft by which the mill is put in motion; E E, revolving arms or breakers, with teeth projecting both upwards and downwards, which crack the bark as it passes into the mill; F G, the regulating beam, which is operated upon by the screws, H I, and raises or lowers the revolving cone, as the bark requires to be finer or coarser.

Fig. 2 represents the revolving arms as seen in Fig. 1, E E, attached to the upright shaft C, which passes through

the mortice O. The object of these arms is to prepare the bark for the mill.

The following is one of the numerous favorable letters from one who has used the mill; and of Mr. Williams, we can speak as a competent and judicious judge of its merits.—[Ed. M. M.]

Messrs. Seabury & Young:

Gentlemen,—The bark mill I purchased of you I have had in operation about five weeks. I am highly pleased with it, and prefer it in my establishment to any one I have ever used. As an experiment, I have ground half a cord of bark in twenty-eight minutes, (forty-five revolutions,) and ground it well. I can cheerfully recommend it to the public, as a valuable improvement. Should you consider the above of any service to you to present to the public, you are at liberty to publish it. Thomas Williams.

Vernon, Nov. 30.

---

*Apparatus for Making Ship's Biscuits.* By Thomas Tassell Grant, Esq., of Weovil, near Portsmouth.*

The advantages claimed for the new, over the old method of preparing ship's biscuit, are, superior economy and expedition, greater cleanliness in the process, and a better quality in the manufactured article.

The mode of making ship's biscuit, as practised in the king's bakehouse at Portsmouth, was as follows:

Five men were appointed to the service of each of the nine ovens, being forty-five in the whole.

The first of these was the idleman, whose business was to mix the meal and water in due proportions, and to incorporate the materials as accurately as possible by kneading the dough for half an hour, with his naked arms plunged into it up to the elbows, and finishing the operation by jumping into the trough and treading the dough with his feet. Hence it passed to the brakeman, who completed the kneading by means of a lever, on which he pressed with his whole weight, this part of the process being called riding down the dough.

It then passed into the hands of the furner, who first divided the dough into lumps somewhat bigger than an egg, and passed them on to his mate, who pressed and moulded each by hand into the form of a biscuit, and finished by pricking them with an iron instrument, to prevent blisters from rising in the dough during baking.

The biscuits being thus formed, were supplied in succession to the pitcher, who threw each on the peel of the furner as soon as he had deposited the previous one in its proper place in the oven. Each oven was capable of holding 450 biscuits, weighing together one hundred weight; and two charges, that is, 900 biscuits, were baked in an hour.

The above-described process, besides the general slovenliness of it, was liable to the two following disadvantages:

It was not possible for the idleman and brakeman, with all their care, to effect a perfect and uniform mixture of the flour with the water; the consequence of which was, that the wetter portions detained some of the water till it was boiling hot, and in that state re-acted on the starch of the flour, so as to give the biscuit, when dry, a glossy fracture and almost stony hardness.

Neither could the furner divide the mass of dough into lumps of perfectly equal size, in consequence of which, the biscuits being of various thickness, the thinner ones were scorched in the baking, and the thicker ones were under-baked, so that they soon became mouldy in the close warm air of a ship's bread-room.

In Mr. Grant's apparatus, the greater part of the labor is performed by steam power; the nine ovens are heated by one continuous fire-place, the flame of which is admitted by means of a register into each oven as soon as the previous charge has been withdrawn, and in five minutes brings it to a sufficient heat. It takes fourteen or fifteen minutes to bake each charge, so that three charges can be worked off in one hour, being an advantage in point of expedition of one-half more than by the old method.

This apparatus was first erected at Weovil, near Portsmouth, in the year 1832, under the immediate superintendence of Sir John Rennie, and has continued at work successfully up to the present time. It has since been adopted,

* The large gold medal was voted by the Society of Arts for this apparatus.

Fig. 1.

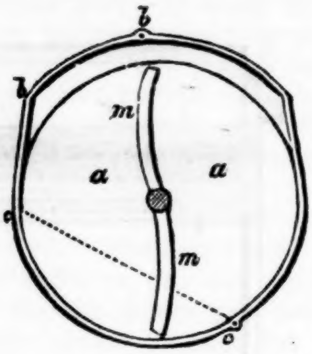



Fig. 2.

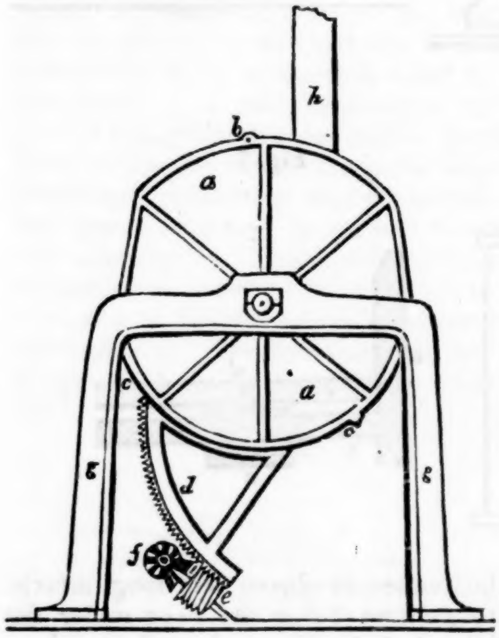
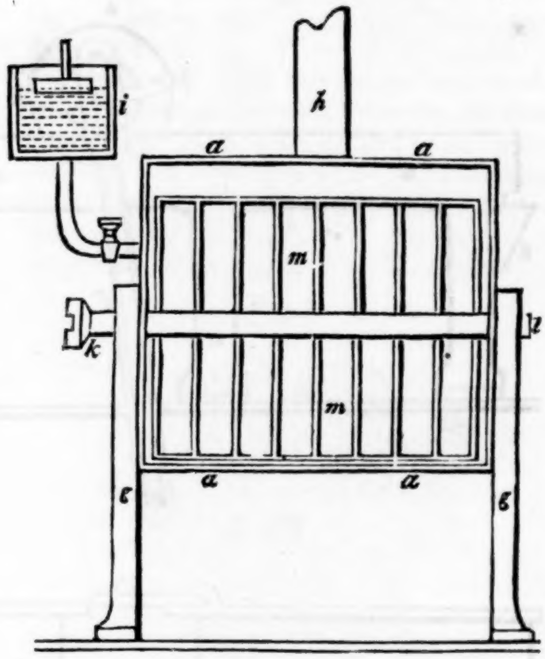



Fig. 3.




with certain modifications, at the bake-house of Messrs. Fraser and Hullah, of Wapping, who have kindly permitted the Society to inspect it, and to take the requisite observations for preparing the annexed sketches and description, by which it is hoped that it will be rendered generally intelligible.

The first machine is the mixer, of which fig. 1 is an end elevation, fig. 2 a transverse section, and fig. 3 a longitudinal section. It consists of a cast-iron case, *a*, *a*, nearly four feet long and three feet in diameter, enlarged, however, at the upper part, a few inches beyond the circular form, as shown by the upper dotted line in fig. 2. The radical lines in fig. 1 are merely ribs to strengthen the end of the case. A flap or door, *b*, *b*, the whole length of the case, opens upwards, to enable the workmen at any time to inspect the interior; and another larger flap or door, *c*, *c*, opens downwards, for the purpose of removing the contents of the case. This latter door is opened and shut by means of a quadrant-rack, *d*, worked by an endless screw, *e*, which is moved by a pair of bevel pinions, *f*, and these are acted upon by a small winch and axle attached to the supports, *g*, *g*. The operation of this machine is as follows: The requisite quantity of flour is sent down from the loft above by the shoot, *h*, and the proper quantity of water is supplied from the small cistern, *i*, which has a float and gauge, with a line and pulley, to indicate the quantity admitted from a larger cistern above, and a pipe and cock to convey the water into the case. The flour and water being admitted, the central axle or shaft, *k*, *l*, is put into gear with the steam engine by means of the coupling-box, *k*; the axis is thus made to revolve very rapidly, carrying around with it the frame of eighteen knives or mixers, *m*, *m*. These knives, which are curved, as shown in fig. 2, are two inches wide, and three-eighths of an inch thick at the back; they are connected at their extremities by similar longitudinal knives, which, in revolving, almost touch the lower part of the case. By these means it is evident that the

Fig. 4.

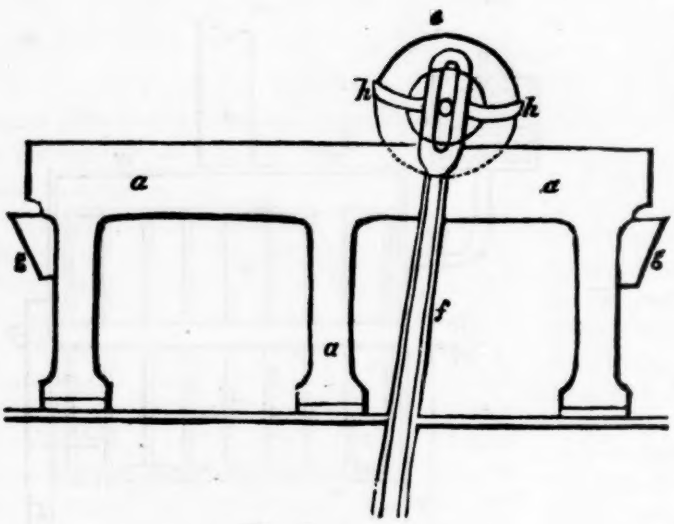



Fig. 6.

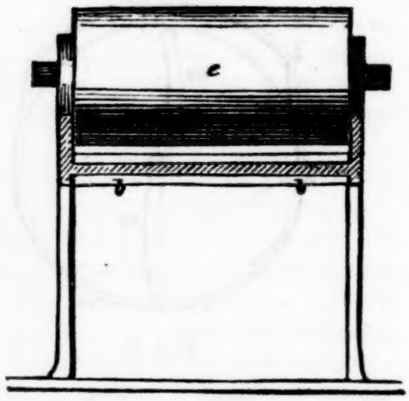



Fig. 5.

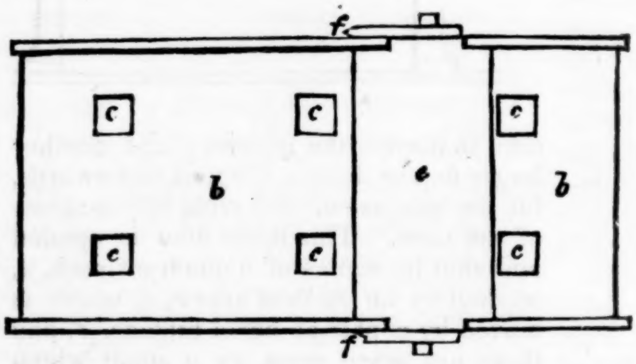
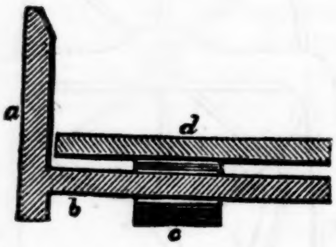



Fig. 7.




flour and water must in a short time become thoroughly mixed. The paste is then removed by hand through the door, *c*, *c*, and placed upon a table, which is as close as convenient to the mixer, and which is now to be described.

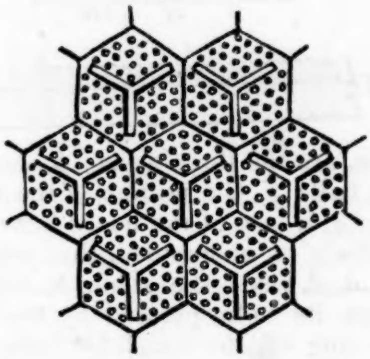
This table is shown in an elevation fig. 4, plan fig. 5, and transverse section fig. 6. It has a cast-iron frame and legs, *a*, *a*, *a*, a cast-iron bed, *b*, *b*, (six feet and a half long and three feet wide,) in which are the six holes, *c*, *c*, &c., to receive friction-rollers, on which run the boards to receive the dough. Fig. 7 is an enlarged section of the side, *a*, of the table; *b*, is the bed; *c*, one of the friction-rollers; and *d*, the board. The sides, *a*, *a*, of the table support a very heavy cast-iron roller, *e*, eighteen inches in diameter, which, when resting on the table, is about two inches clear of the board, *d*. This roller is made to run alternately, and with great rapidity, from one end of the table to the other, by means of a pair of beams ten or eleven feet long, attached to centres below the floor under the middle of the table, and made to alternate by a crank from the steam engine; the upper end of one of these beams is seen at *f*, fig. 4, showing the groove in its extremity, to allow the axis of the roller to play in it as the beam alternates. It will now be evident, that when a mass of dough or paste is taken from the mixer and placed upon the table, it must quickly be compressed by the roller into a cake equal in thickness to the distance of the roller from the board, which, in this case, is two inches. During this process a considerable quantity of dry flour is sprinkled on the dough and on the board, a large portion of which would be swept off by the roller and lost, but for the troughs, *g*, *g*, at the ends of the board, which catch and retain it. Notwithstanding this sprinkling with dry flour, a small quantity of dough would occasionally adhere to the roller, were it not kept con

stantly and perfectly clean by means of two thin knives, extending on opposite sides along its whole length, and attached to two pairs of curved arms, one pair of which, *h*, *h*, is seen fixed to the beam *f*. When this operation is finished, the board with the dough is withdrawn, and another board introduced, on which the process is repeated. The first board and dough being withdrawn, are conveyed on a series of friction-rollers, to a second table, precisely similar to that just described, except that the roller approaches to the board within such a distance as is required for the thickness of the biscuit. The dough, which was reduced to a cake two inches thick at the first table, is cut into pieces, and laid in portions on the second table, where it is quickly brought down to the proper thickness for biscuits. The board containing this comparatively thin sheet of dough is pushed forward, still running on friction-rollers, towards a machine next to be described, while the workmen at the second table repeat their operations on the fresh portions of the dough which they have received from the first.

Fig. 8.


The machine, towards which the board and sheet of dough now rolls, is shown in fig. 8: it consists of a strong cast-iron frame, *a*, *a*, *a*, with cross-beams, *b*, supporting three or more pairs of rollers, *c*, *c*, on to which the board is pushed. Immediately above is a thick plate of cast-iron, *d*, *d*, three feet square, which is made to ascend and descend alternately by an eccentric, which acts on the rod, *e*, the lever, *f*, and the guide-rod, *g*. The iron plate, *d*, is shown in the figure at its lowest position; it is, of course, at its highest when the dough and board are brought under it. When this is done, it descends and cuts the dough into hexagonal pieces or biscuits, by means of thin knives, one inch wide, affixed to its under surface, and arranged so as to form hexagonal spaces. A small part of the under side of the plate, *d*, *d*, is shown on a larger scale in fig. 9, where, in addition

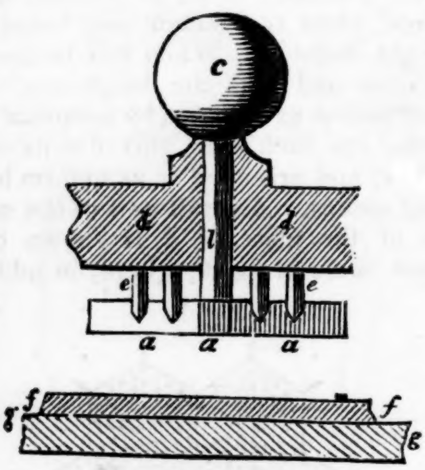
Fig. 9.



to a portion of the hexagonal knives or cutters, will be seen a number of small dots or circles, which indicate the pins or prickers to give the requisite punctures to the biscuits before they are baked. These pins are as long as the depth of the hexagonal cutters; that is to say, one inch; they are about one-third of an inch in diameter, and pointed at their extremities.* The effect of all these cutters and pins would, however, be to cause the plate, *d*, to cling to, and lift with it, the sheet of dough. In order to prevent this, a very ingenious contrivance is introduced; a part of which will have been observed in fig. 9. In each hexagon will be seen three arms, branching from the centre. These are formed of iron, and each set is connected with a small vertical iron stem, which passes through the plate, *d*, moving easily, and is surmounted by an iron ball, two inches in diameter, acting as a weight to press the stem and the arms downwards. One of these balls, with its stem and arms, and a portion of the plate, *d*, *d*, is shown in fig. 10, where

* It will be recollected by those of our readers, who have been subscribers from the commencement, that we gave, in the October number of vol. ii, a description and engraving of a cracker machine—of the relative merits of which we are not able to speak.—[Ed. M. M.]

Fig. 10.




*a*, *a*, *a*, are the three arms; *b*, the stem; *c*, the ball; *f*, *f*, a portion of the dough; and *g*, *g*, a part of the board beneath. It will easily be understood, that when the plate, *d*, *d*, rises, the stem, *b*, will drop through its hole, pressed by the ball, *c*, and acting on the dough by the arms, *a*, *a*, *a*, will disengage it from the hold of the prickers and cutters. When the plate, *d*, *d*, descends to cut the dough, of course the arms, *a*, *a*, *a*, rise up to the plate, and the stem rises upwards in its hole, carrying with it the ball. There are as many of these balls and stems as there are biscuits, that is to say, about sixty in each square of three feet. These balls would therefore be seen on the upper side of the plate, *d*, in fig. 8; but they are omitted for the sake of avoiding confusion.

The hexagonal cutters do not so completely separate the sheet of dough as to prevent its being put whole into the oven, into which it is introduced by being laid on a plate of iron, which fits on to the handle of the peel by a bayonet-joint. The sheet of dough, when baked, is broken into biscuits, which take the form marked out by the cutters.

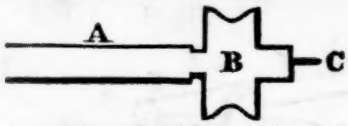
The arrangement of the several machines would, in some measure, depend on the form of the building and other circumstances. They should be as near together as is convenient, in order that the boards may pass from one to the other on rollers; the mixing machine should be near the supply of water and flour; and the cutting-machine should, of course, be near the oven. A series of rollers should be fixed against the wall, for the purpose of returning the boards to the first table after they have been emptied. At Portsmouth, this series of rollers was kept constantly revolving by the steam-engine, so that when the empty boards were placed upon any part of the line, they travelled up to the mixer without further attention. —[Transactions of the Society of Arts.]

---

[From the London Mechanics' Magazine.]

## *Easy Method of Drilling Holes in Glass for Philosophical Instruments.*

Sir,—Having discovered what I consider to be a new and also very superior method of cutting holes in plate glass for electrical and other machines, and also of cutting glasses for optical instruments, I am induced to send you a description of the same, in order that it may be beneficial to others. I will first describe the instrument necessary to be made for the purpose, and then state how it is to be used. Make of thick sheet tin a tube 3 or 4 inches long, the diameter of which, measuring from the *outside* edge, must be somewhat smaller than that of the hole required. Let this tube be converted into a drill, thus:




A is the tube; B the head of the drill, turned out of the wood, part whereof goes about an inch into the tube; C is a piece of iron wire for the pivot. The open end of the drill should have a few notches made in it with a file, so as to admit the emery, necessary to work with facility.

Determine the size of the hole you want, say half an inch in diameter; then cut such a hole in a piece of flat wood, being not less than 2 inches square, and half an inch thick. Next, mark on the plate glass the situation of the hole wanted; take some melted beeswax, with, or without rosin, and fix the piece of wood on the glass, having the hole exactly over the place previously marked; place the glass on something flat, whereon some baize or carpet has been first laid, to prevent the glass from sliding during the process; mix plenty of grain emery with water, and put it into the open part of the drill; now place the drill in the hole of the wood, and with a breast-plate

and drill bow, about 2 feet long, commence drilling. You must work at first very slowly to avoid chipping the edge of the glass, and afterwards proceed at a quicker rate, always taking care not to press on the drill more than sufficient to keep it steadily working, for otherwise there will be great danger of breaking the glass. When the drill is almost through the glass (which may be ascertained by looking at the other side of it), you must remove the carpet or baize, above alluded to, to obviate the danger of chipping the edge of the hole, and then proceed very slowly until the operation is quite finished. You will thus obtain a clean edged circular hole, with a corresponding piece of glass, and this without incurring the least risk of breaking. In this way a piece of plate glass, a quarter of an inch thick, may be cut through in less than ten minutes.

I have adopted this mode of cutting holes in plate glass for electrical machines, and it is obvious that it may be also applied to the cutting of glasses for optical instruments. Here, however, the diameter of the *inside* of the drill must, to allow for friction, be a trifle larger than the diameter of the glasses required; for if no allowance be made, it will be found that the piece of glass will be somewhat smaller than was required.

I am, &c. F. H.

Bath, Dec. 29, 1834.

---

[From the Journal of the Franklin Institute.]

*Report on Thomas Ewbank's New Process for tinning Lead Pipes.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the mechanic arts, to whom was referred for examination specimens of lead pipe, coated with tin, made by Thomas Ewbank, of the city of New-York, report—

That they have examined the specimens of tinned lead pipe submitted to them, and are fully satisfied that the coating of the lead with the tin is complete; and from a description of the process accompanying the specimens, the committee are induced to believe, that when the pipes are of a limited length, it cannot fail, if proper care be taken by the person who conducts the operation

The superiority of this method over any former plan known to the committee, is the facility with which the pipes are tinned, merely by drawing them through a bath of fluid metal.

The committee would, therefore, recommend to the Board of Managers the award of the Scott's legacy premium and medal to Mr. Ewbank, for his important improvement in the process of tinning lead pipes, whereby the cost is but little enhanced, which brings them within the reach of all who may have occasion to make use of the article.

By order of the Committee.

WM. HAMILTON, Actuary.

March 12, 1835.

---

[From the London Mechanics' Magazine.]

*Penny's Improved Cutting-Presses.*

Sir: The stationers' cutting-press is a tolerably convenient and efficient machine in the hands of experienced workmen; but it requires great practice to obtain any thing like expertness in the use of it. Various attempts have, therefore, been made, to give this machine the means of adjusting itself, and insuring perfect accuracy, independent of any degree of skill possessed by the workman. The most recent contrivance for this purpose is one by Mr. Penny, who has succeeded in introducing several decided novelties and improvements into this machine.

It will very likely be in the remembrance of many of your readers, that your ingenious correspondent, Mr. W. Reed, of St. Petersburgh, invented a machine for ploughing the edges of paper, worked by steam-power. This machine, however, is liable to the same defect as the common cutting-press, viz. that the reams of paper are not cut true—always deviating more or less from the square.

Mr. Penny's attention having been attracted by the palpable defects of the stationers' cutting-press, he has produced one, not liable to the same objections.

In order to make his press capable of such nice adjustment, as to insure accurate workmanship, Mr. Penny has introduced a moveable stage for receiving the paper or book to be cut; and as this stage is so situated as to be at all times parallel with the upper surface of the press where the plough runs, it will be seen that the object in view has been effectually obtained.

Mr. Penny's press, as he first constructed it, was of the form represented in the rough sketch, figure 1. A represents one of the cheeks, the other being exactly behind it; *b b* are the two tightening screws;

Fig. 1.

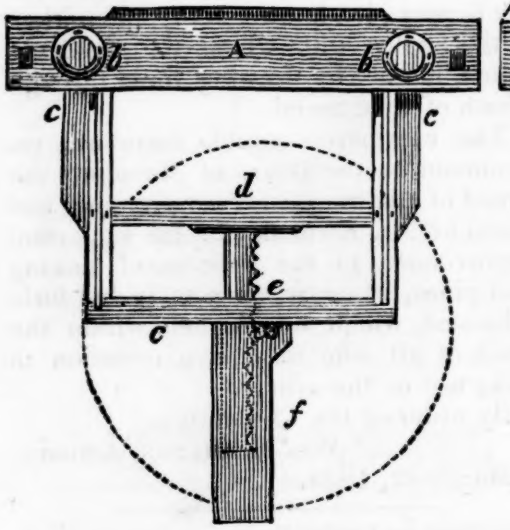



Fig. 2.

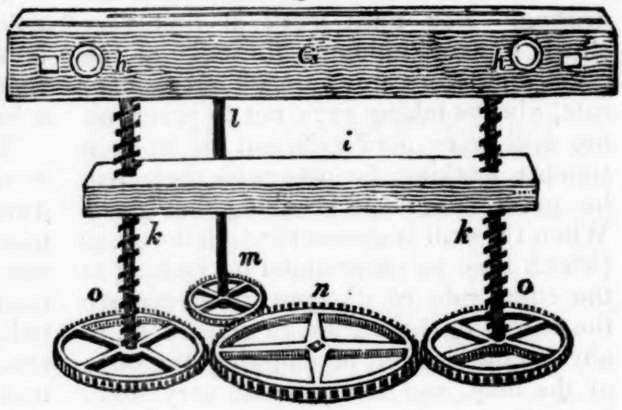
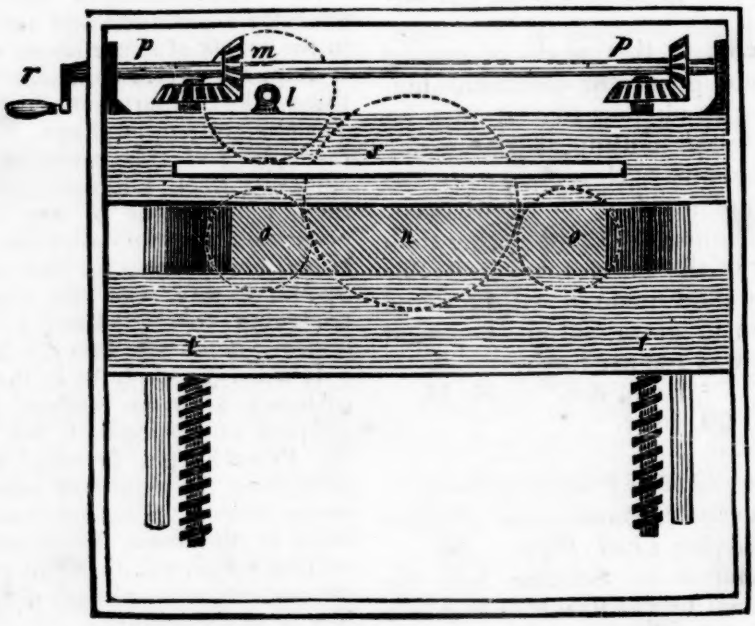



Fig. 3.




*c c c* is a perfectly square frame or box, fitted very truly to the left cheek of the press, the back of the box being flush with the face of the cheek; *d* is a platform, or stage, moving within the frame just described, and raised or lowered by means of a rack on its underside, acted upon by the pinion *e*. Motion is communicated to the pinion *e* by means of a large wheel on its axis, placed on the left side of the press, which the workman turns with his left hand; the platform is retained, at any required height, by a spring-catch, which takes hold of the large wheel.

The side of the frame *c* being accurately fixed at right angles to the upper face of the cutting-press, and the stage *d* parallel thereto, it necessarily follows, that any paper placed upon the stage must be cut perfectly square, all the edges being parallel to, or at right angles with, each other.

Some objections, however, were made to this press on account of its height; for it required to be elevated a good step in consequence of the length of the rack-case *f*, except where this part could be let into the floor.

To obviate this objection, Mr. Penny adopted another arrangement, which will be understood on reference to figs. 2 and 3, which are sketches of the construction last employed. I have seen and used a full-size cutting-press of this description, manufactured by Messrs. Adamsons, of Back

Church lane, Whitechapel, which fully bears out the inventor's expectations.

Fig. 2. G is the cheek of the press; *h h* the tightening-screws. The moveable bed *i* is raised or lowered by turning the two screws *k k*. In this figure the frame-work of the inclosing box is omitted for the sake of distinctness. The screws *k k* are turned by means of four cog-wheels, beneath the bottom of the press, motion being given, through the medium of a handle on the upright shaft *l* of the wheel *m*, to the centre-wheel *n*, which turns the wheels, *o o*, carrying the screws.

Fig. 3 is a plan of the press as it appears to a person looking down upon it. The dotted circles show the situations of the respective wheels, but without any regard to their relative proportions; *l* is the upright shaft, on which a key-handle is placed by the workman, to raise or fall the platform. In this press, it will be seen that Mr. Penny has introduced a most ingenious and simple method of giving simultaneous and equal motion to the two tightening screws; he has accomplished this by the introduction of two bevel-wheels, placed on the axle *p p*, which take hold of two other bevel-wheels fixed on the screw-heads. The screws are iron. A piece of board covers over this part of the movement, to keep out dirt, shavings, &c., and being flush with the surface of the cheek, forms a convenient shelf for holding paper, &c., a hole being left for the handle.

*s s* is a steel rail for the plough to run upon, instead of the wooden guides commonly used for that purpose; *t t* is another similar rail on the right cheek, the use of which I shall explain in another communication, descriptive of Mr. Penny's improved bookbinders' ploughs. By means of a piece of sliding canvas, attached by its upper edge to the platform *i*, and a wooden bottom or flooring over the wheels, the shavings are prevented from getting entangled with the works.

This press offers many great advantages: besides insuring perfect accuracy of workmanship, twice the usual quantity of paper, or books, may be cut at once, and with greater rapidity. In cutting and gilding of highly-glazed and other paper, and in burnishing of book-edges, there is no danger of the paper falling through.

From the quantity and quality of workmanship necessarily expended in constructing one of these presses, they are much more expensive than the common press; but to persons having full employment for them, they soon repay the difference of cost. They are very well adapted for the use of country stationers, and amateur bookbinders, who experience much trouble from the inconvenience which is obviated in Penny's press. I remain, Sir, yours respectfully, Wm. Baddeley.

February 10, 1835.

---

### PENNY'S IMPROVED PLOUGHS FOR STATIONERS, &c.

Sir: At page —, of the present volume, you inserted an account of Mr. Penny's improved cutting-presses. I now beg to hand you the promised description of two ploughs adapted to them, or which may be applied with considerable advantage to cutting-presses of the usual construction.

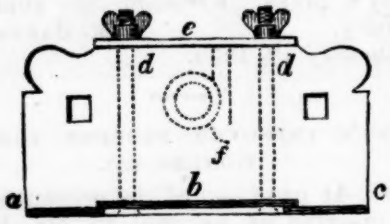
In the ordinary machine, the plough-knife is held in its place by a single square bolt, passing up through the cheek or side of the press, and fastened by a thumb-screw at the top. The knife having but *one* stay, and only bearing upon a small wooden surface, it requires to be screwed very tight, and even then is found to spring and cut the paper, &c., unevenly. To remedy this, it becomes necessary to *dress* the knife, by placing slips of paper or pasteboard under the knife, before or behind the bolt, as the case may be, to bring the knife to a level. The conformation of the knife itself frequently increases the deviation, and renders a different quantity and position of dressing needful with every fresh knife.

All these, and many other inconveniences, are very completely obviated by Mr. Penny's mode of constructing his ploughs.

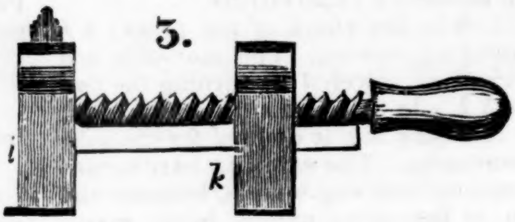
Fig. 1 is the knife-cheek of Penny's plough, of the usual form and dimensions, but it has a brass plate or shoe at the bottom, *a b c*, which forms the bearing of the plough, and a firm, unalterable bed for the knife; the knife is securely held in its place at *b*, by the two square iron bolts at *d d*, fastened by thumb-screws, working on a metal plate *e*. The wooden screw is made to carry this cheek by a pin *f*, which works in a groove cut for the purpose. Fig. 2 is another view of this plough, turned knife uppermost, showing the form of the knife, *g*, and also the brass plate on the other cheek, *h*, with the groove to run upon the iron rail (vide *s s*, page 296.) The metal plate or sole once being made true, it does not become changed, but remains perfectly level; and the knives being the same, no dressing is required. The knives for this plough require to be very carefully made; they should be cast steel, and any that are warped should be thrown aside by the workman, and not finished up.

In the year 1832, Mr. Penny received 5*l*. from the Society for the Encouragement of Arts, &c., for his improvements in stationers' ploughs; but, judging from the descrip-

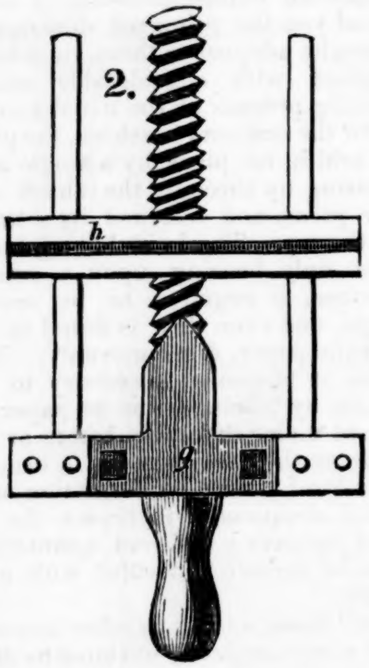
1



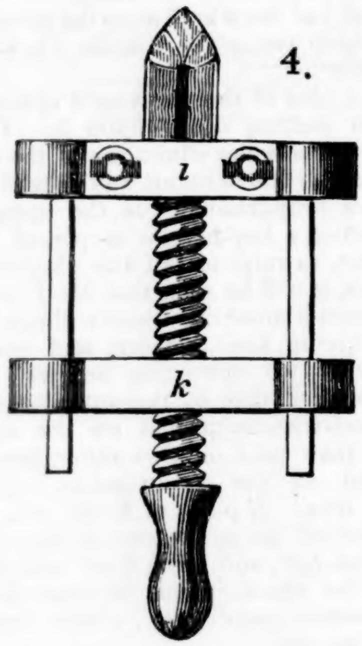

3.




2.




4.




tion of it published in the 49th volume of the Society's Transactions, they understood but very imperfectly the nature or extent of the improvements introduced.

Fig. 3 represents a new plough invented by Mr. Penny, for the purpose of cutting off strips of paper, &c., of a much greater height than can be accomplished by the highest ploughs of the present form. In this plough the knife is attached to the left cheek of the plough *i*, which traverses, while the other cheek, *k*, runs steadily upon an iron rail, placed on the right hand side of the press for this purpose. Fig. 4 is a perpendicular view, downwards, of this plough, which shows more clearly the arrangement of all its parts. With a plough of this kind, pieces of unlimited height may be cut off; and it will be found extremely useful by stationers, bookbinders, printers, and others. It fully answers the purpose intended, and is much more conveniently handled, than, judging from its appearance, might be anticipated.

There is a decided advantage in the position given to the knife in these ploughs, which being central and directly under the screw—to which the power is applied—cuts more steadily, has less inclination to spring and twist, and is more easily managed than in the old ploughs. I remain, yours respectfully, Wm. Baddeley.

London, March 17, 1835.

---

Improvement in Fire-Tongs. — Sir: To *prevent* pieces of coal slipping and falling from the tongs, in carrying them from the scuttle to the fire-place, (which is often the case,) and by which hearth-rugs and carpets are injured and soiled, I have rivetted four small sharp spikes, of *well tempered steel*, into each lip of the tongs, projecting about ¼ of an inch, which completely answers the purpose. The utility I have experienced in this trifling invention, induces me to send it for insertion (if you think it proper) in your useful and excellent Magazine, that others may reap advantages from it as well as myself.

I am, Sir, your obedient servant,

J. Bullen, Rear-Admiral,

Bath, Feb. 17, 1835.

[From the American Railroad Journal.]

## *Remarks on the Substitution of Locks for Inclined Planes on Railways.*

The disuse of stationary steam power on railways has long been an object whose attainment has been anxiously desired, but hardly expected. Attention to this subject is daily increasing, as its importance is continually growing more apparent.

The efforts of ingenuity have heretofore been generally directed to improvements in the locomotive engine, by which it would be enabled to move up very considerable ascents by its own unassisted strength. In a late number of the Railroad Journal, I find an extract from a Baltimore paper, stating that an engine had been fabricated in that city able to rise on an elevation of two hundred and sixty feet in a mile, or one foot in twenty; and the belief is expressed, that the same species of engine would be capable of carrying one hundred passengers in a train of cars, up an acclivity of one hundred feet in a mile, at the rate of ten miles an hour.

This may perhaps be all accomplished, but still I have doubts as to the substantial utility of such an achievement. For the attainment of the greatest degree of economy, all the power of the engine, which may be safely exerted, should be constantly employed. But if sufficient energy is provided to rise such steep acclivities, there must be an immense superabundance and waste throughout all the other portions of the route.

In a report of the commissioners of the Liverpool and Manchester Railway, made to the House of Commons a few years since, it is stated, as the result of experiment, that an engine capable of moving thirty tons over a level track could raise no more than seven tons on an elevation of one foot in a hundred, or about fifty-two in a mile. If this be true, the same engine would be unable to draw more than three tons at the utmost, where the ascent was a hundred feet in a mile, since the load capable of being propelled would have to be diminished much faster than in a direct proportion to the degree of acclivity; and since the engine and its appurtenances occasion almost the sole expense of transportation, the cost of carrying three tons over such an undulating road would be nearly equal to the freight on thirty tons upon a level way. The whole load which an engine can transport will be limited by what it can move over the most difficult part of the way. Now, I do not doubt but that engines may be constructed capable of raising a load on an elevation of one hundred feet in a mile, but would it not be wiser to construct the road more nearly level, so that the same engine might carry a load several times as large? Where the transportation of passengers is alone concerned, economy being of little consequence in comparison with speed, such a waste of power may be justified; but where intended principally for the carriage of freight, where the diminution of expense is the principal object, there are very strong objections to an arrangement by which a large proportion of the propelling power lies waste and idle during the greater part of the journey, to be exerted only on the ascent of eminences.

In England, where there is much more experience than in this country, not only in the construction, but also in the operation of railroads, it is considered unwise to attempt the ascents of more than fifty feet in a mile by the sole power of the locomotive.

But it is not merely a want of power which fixes a limit to the degree of ascent practicable on railways. No matter what the ability of the engine, if the adhesion of the wheels to the rail is not sufficient to prevent them from sliding round in their places, the load cannot be moved; and this it is which, more than any thing else, renders rapid ascents impracticable. Experiments made when the wheels and rails are new, and not yet worn smooth by use, are not satisfactory upon this point, especially when it is recollected that those rails may not unfrequently be rendered slippery by ice or snow. The importance, therefore, of resorting to some other substitute for inclined planes, beside those hitherto contrived, is sufficiently evident.

An expedient of such a nature has lately received some notice, not only in the columns of this Journal, but also in those of several other public prints of this city. I refer to the railroad lock invented by Colonel Taylor. An attentive examination will, I think, convince any one, that its operation is founded upon well estab-

lished principles of mechanical philosophy, and that it must prove successful.

The great object of the lock in question is to enable the locomotive engine to raise itself and all its train by its own unassisted strength, over any elevation, no matter how high, or how steep. This object is attained by a recourse to that universal mechanical principle, that what a power wants in intensity may be made up for in distance; that if it is only the half of what would be required to move a given weight on a direct application, such machinery must be interposed as that the distance through which the power moves may be twice as great as that through which the weight is raised. The merit of the invention in question consists in this: That when an ascent is to be overcome, and the power ordinarily required becomes insufficient, a provision is made by which the distance traversed by it may be any number of times greater than that ascended by the weight, so that no additional force is called for to assist the locomotive in any emergency.

This is accomplished by the agency of screws, which being moved by the power of the locomotive itself, elevate the engine and all its train perpendicularly from one reach to another. It will be readily perceived that such machinery may be interposed between the power and the load, that the distance traversed by the former, that is to say, the space through which the piston moves, shall bear any necessary proportion to that ascended by the latter, and thus success be rendered certain.

As has been already observed, the great object to be attained in order to secure the strictest economy in transportation, is such an arrangement that the power required to propel the load may be the same throughout every portion of the route. Now suppose the road to be perfectly horizontal, and all changes of level between one reach and another to be effected by the locks in question; and suppose the machinery of those locks to be so constructed and proportioned that the same power which propels the load upon the rails should be just sufficient to raise it upon the locks, the object desired is completely attained. Not one ounce of power would lie idle throughout any portion of the route—not an ounce would be wanting. There would be neither loss nor deficiency, and the system, so far as economy of transportation was concerned, would be perfect.

Such a state of exactness would not, however, be necessary or advisable. The increased expense of grading would more than counterbalance the advantage to be gained from a perfectly level road. The power of a steam engine is not fixed and invariable. It may to a certain extent be increased without detriment, so as to enable it to rise over moderate elevations. Still it is sufficiently evident, that although it may not be practicable to carry the proposed system to a degree of absolute perfection, yet that state may without difficulty be so nearly approached as to secure the greatest advantages.

I have at this time paid no regard to the superior excellence of the lock in question, so far as safety, convenience, and economy of construction, were concerned. This might be readily shown, and in many respects will be at once perceived, without further explanation. There is every probability, therefore, that success will crown this endeavor to improve the construction of railways, and will, I trust, become an important era in the history of internal improvements.

M.

---

Stump Lifter.—Capt. L. Norcross, of Dixfield, Maine, has invented a new machine for lifting out or removing stumps. It consists of a large screw placed in a nut, which is attached to legs like those of a surveyor's compass. These, being sufficiently strong, are placed above the stump, and it is then grappled to the screw by chains or hooks. A large sweep, like that used in some old fashioned cider mills, having a nut to fit, is put upon the screw, and horses or oxen hitched on the other end, by means of which the stump is raised from the ground by driving round the sweep.

---

[For the Mechanics' Magazine.]

### *For Musical Instrument Makers.*

To make a bass-viol a third or fifth, or any degree higher, or lower toned, that given, the strings of the same tension.

*Rule*—Cube the dimensions of the given viol, multiply by the degree you would lower it, whether second, third, or eighth; the cube root of the product will be the dimensions required. Or, if to raise the tone, cube the dimensions of

**the given viol, subtract the degree required to raise it, and extract the cube root of the remainder, for the required dimensions. S. A.**

[For the Mechanics' Magazine.]

**SLUICE GOVERNOR, OR REGULATOR.**

**This is a contrivance to regulate the water on a water-wheel. It is also applied to the steam engine. It is commonly made with an upright shaft; and attached to it near the top, by means of joints, are two arms, which are from twenty inches to two feet long. On ends of these arms are two balls of cast iron, of an oval shape, about 30 lbs. each, and are so contrived, that when the motion of the wheel is too quick, these arms will expand, or spread apart; and, if the motion is too slow, the arms will contract or fall together; consequently, by means of shafts and gear work, the gate is raised or lowered, which keeps a regular motion on the wheel.**

**This is rather a difficult machine to put in operation, to have it perform well. It requires a very close calculation to make and adjust all the parts of a regulator properly, to have it work with ease.**

**I therefore thought, (to assist some of my "fellow craft,") I would lay before them, through the "Mechanics' Magazine," a system of calculation, which will answer equally well for all kinds of regulators, by varying the process according to the construction of the regulator.**

**We will then suppose the main drum of a mill to perform 65 revolutions per minute. It is necessary in all cases to move the gate at the rate of about one inch per minute. This being understood, we will suppose the regulator arms to be 21½ inches long, which is the length between the point of suspension and plane of revolution, which also is equal to the length of a pendulum, the vibrations of which will be double the revolution of the balls.**

**Then, to find the revolution of the balls, first, find the vibrations of a pendulum of equal length with the arms, by the following**

***Rule.*—The square root of 39.2 inches, (the length of a pendulum that will vibrate seconds,) multiplied by 60, and divided by the square root of the given pendulum, will give the number of vibrations required.**

**Thus, $\sqrt{39.2} \times 60 \div \sqrt{21.5} = 86$, the number of vibrations per minute, the half of which is 43, the revolutions required for the balls of the regulator; then, to obtain this motion, multiply the diameter of pulley on main driver by its number of revolutions, and divide by the number of revolutions of the regulator. We will suppose the pulley to be 12 inches diameter. $12 \times 65 \div 43 = 18.139$ inches diameter for pulley that drives the regulator.**

**We will now suppose a regulator to have arms 21.5 inches long, as above stated, and balls to weigh 30 lbs. each. We will also suppose the gear or regulator to have 50 teeth, and to gear into a wheel on the first horizontal shaft of 75 teeth; on the other end of this shaft is a pinion of 15 teeth, which gears into a wheel on a second shaft of 43 teeth; on the other end of this shaft is a worm, or endless screw, which gears into a wheel of 125 teeth, and on the end of the rack pinion shaft; the pinions are 4 inches diameter. We will then take the following**

***Rule.*—Multiply all the drivers into each other, and that product by the revolutions of the regulator per minute, for a dividend, and the leaders into each other for a divisor; divide one by the other, and the quotient will show the revolutions of the worm shaft per minute.**

**Examples: $50 \times 43 \times 15 \div 75 \times 43 = 10$, = the revolutions of worm shaft per minute.**

**Now, as it is required that the gate should move at the rate of one inch per minute, consequently, the teeth of the rack pinion must move at the same rate; and calling the pinion 4 inches diameter, or 12.571 inches circumference, we find it necessary that the wheel or pinion should perform one revolution in about 12.5 minutes, and having the motion of the worm shaft, we will proceed to find the number of teeth for the last wheel, or wheel that the worm works in.**

***Rule.*—Multiply the revolutions of worm shaft per minute, by the time in which the rack pinion shaft performs one revolution, the product is the number of teeth required.**

**Examples: $10 \times 12.5 = 125$, the number of teeth required; we then have, $75 \times 43 \times 125 \div 50 \times 43 \times 15 = 12.5$ minutes, the time in which the rack pinion shaft will perform one revolution.**

To find the centrifugal force of balls, on any body revolving around its axis.

Multiply the weight of the body in pounds by the square of the number of feet passed over in a second of time; then divide the product thus obtained by sixteen times the diameter of the circle in feet, the quotient will be the absolute centrifugal force in pounds.

For example: Suppose the balls of a governor to weigh 30 lbs. each, and revolve in a circle three feet diameter, in one second of time, thus: $3.1416 \times 3 = 9.42$ feet per second.

$9.42^2 \times 30 \div 16 \times 3 = 55.33$ lbs., = the centrifugal force. S. A.

[From the New-York Farmer.]

## *Description of a Cast Iron Flower Stand.*

Sir,—The accompanying drawing is my new Flower Stand, which I have just designed and executed for my much esteemed friend, the Rev. T. Mackreth, the patron of the Lancaster Floral and Horticultural Society, which is well calculated either for plants growing in pots, or for cut flowers placed in glass basons, for drawing rooms. It has a most elegant appearance, being either brass, or cast iron, bronzed; a lamp may be placed on the leaf, A, at night, which will produce a beautiful effect; and during the day many pleasing objects may be placed on A, to appear amongst the flowers. The number of brackets, 2 2 2 2, may be increased to any amount, according to the quantity of flowers wanted to be placed on the stand, which are easily attached to the slide, B, by merely taking off A; the brackets move on the slide, B, so that they may be placed in any direction, and the whole can be taken off, and only A remain, when plants or flowers are scarce; the slide, B, may be let down into pillar C, till A rests on the top at 3, and then only one plant or bason of flowers is required for the stand; or any other ornament might be placed thereon. A screw is fixed at D, to set the slide, B, at any height, according to the number of brackets required. This stand may also be used for a hat stand in an entrance, hall, or lobby. The leaves, E, are so cast that they turn on the brackets, 2 2 2 2, with the greatest ease. By a slight inspection of the drawing, I presume it will be easily understood. I have only put one plant upon the stand, so that the leaves, E, may be better seen, and when a bason is placed thereon, it will not be liable to slip off, by the ends of the leaves turning up.

I also send you a correct drawing of my cast iron Chair, which is cast in seven separate pieces, and put together with the greatest ease, and little labor. This chair has now become a great favorite garden seat in this kingdom, notwithstanding the absurd and incorrect drawing given of it in Loudon's Gardener's Magazine, and also the Horticultural Register. I hope your engraver will give it correct from my drawing, so that the American iron-founders may be able to make moulds from it. One mould only will be wanted for the back leaves, A, as the dove is moveable, and may be substituted by any other ornament, and placed at the end of the leaf, in the sand. When moulding, there are three

vine branches to each seat, two in front, and one in the back, so that one mould only is wanted for them; and another mould is wanted for the bottom, if iron. Several have been made here with plain wood bottoms, which are $13\frac{1}{2}$ inches over; they are then screwed on with common wood screws, through the bottom of the leaf, into the edge of the bottom. The vine branches are cast with a piece, so that the screws go into the bottom of the seat, as seen at F. Moulds might first be made in clay, and then a lead cast taken, to take an iron mould from. By a slight inspection of the drawing, I hope no difficulty will be felt in obtaining moulds by any spirited individual, which can be done at less expense than obtaining the moulds from here.

M. Saul.

Lancaster, Engl., Dec. 7, 1834.

---

Avery's Rotary Engine proves, we are much pleased to be able to state, (as we do on good authority,) to be peculiarly adapted to milling purposes. The following statement, which we take from the Syracuse Constitutionalist, confirms fully the anticipations of those who have been familiar with its operations for more than two years; and other instances might be cited, if necessary—one especially, at the south, in which it performs to the entire satisfaction of those using it. Its simplicity, however, and entire safety, cause many to doubt its power, until they witness its performances—which, in some instances, may be said to be truly astonishing. As with many, *seeing* only is believing, we hope soon to be able to exhibit a sample of its performances in this office, attached to the press on which this Magazine is printed, that will satisfy all those who may doubt. When it is in operation, due notice will be given.

"An experiment has been made in Mr. N. Felt's saw-mill, in Cicero, with one of Wm. Avery's patent Rotary Engines, manufactured in this village by E. Lynds & Son, which has satisfactorily proved (if any further proof was indeed necessary) its superiority over any other now in use. Mr. F. some four years since procured a High Pressure Piston Engine for the purpose of propelling the machinery of his saw-mill, but has never been able to produce any satisfactory results, and therefore discarded it entirely. At the suggestion of the Messrs. Lynds, he was induced to make an experiment with one of the Rotary Engines—one of which was accordingly attached to the same boiler used for the other engine, and put in operation. The experiment proved eminently successful, and those who witnessed its performances are well satisfied of its great utility in propelling machinery of every description, and also of its superiority to the engines in common use.

"The following statement of Mr. Lewis, who is deemed one of the first millwrights and mechanics in the state, sustained as it is by the opinions of a number of others well qualified to judge, will go to show in what estimation the invention of Mr. Avery is held by those who have experience in such matters:

"*To the Public.*—Having been requested by Messrs. Elam Lynds & Son, to examine a Rotary Steam Engine, manufactured at their foundry, (of Wm. Avery's invention,) now in Mr. N. Felt's saw-mill, and in which I am informed they have had a common Piston Engine, with which they were unable to operate their mill successfully,—being much pleased with the operation of the Rotary Engine, although it was laboring under great disadvantages, I embrace this opportunity of saying to the public, that I am satisfied that there is abundant power to operate a mill successfully, and I consider them far preferable to any other Steam Engine now in use for milling purposes. "Isaac Lewis.

"Syracuse, April 20, 1835.

"We were present at the above exhibition of the power of the Rotary Steam Engine, and fully concur with Mr. Lewis in his statement, from what we saw of the operation of the Engine, and from our confidence in him as a millwright and a practical mechanic.

| | |
|---|---|
| Roswell Hinman, | Ashbel Kellogg, |
| Thomas Spencer, | J. G. Forbes, |
| M. D. Burnett, | P. D. Mickles, |
| M. S. Marsh, | V. W. Smith, |
| Daniel Elliott, | J. M. Patterson, |
| L. H. Redfield, | E. K. Smith." |

---

The following inquiries have since been addressed to Mr. Felt, to which the answer annexed has been furnished. We recommend the correspondence to the attention of machinists.

We extract the inquiries from a letter to Mr. F. from E. Lynds & Son.

"1st. Have you made any alterations in your boiler, in any form or manner, since

putting the rotary in use, so as to afford more steam with less fuel?

"2d. Is there any difference in the amount of fuel required to perform an equal amount of labor with either of the engines? If so, which requires the least, and what is the difference in the quantity used?

"3d. Does the rotary engine do more or less work, in the same time, than the piston engine? What is the amount of difference?

"4th. Which engine do you conceive to be the most simple in its construction, and in its application to any mechanical purpose the most natural? Also, which is kept in repair with the least expense?

"5th. If you were to put another mill into operation, which engine would you prefer; and which do you think the most valuable for any mechanical purposes?"

*From Mr. Felt, to Messrs. Lynds.*

"Clay, May 1, 1835.

"GENTLEMEN,—It is with pleasure I comply with your request in giving my opinion (founded upon practice and short experience,) in relation to the difference between the former High Pressure and Avery's Patent Rotary Engine, which I now have in operation in my saw-mill.

"In answer to your first question, I would say I have made no alteration in my boilers or arches.

"2d. As to the amount of fuel required, I am not able to answer precisely, but am sure the rotary does not require more than two-thirds the quantity to put it in operation the piston engine required.

"As to the amount of business performed, the rotary will do double the amount of the piston engine in the same time. So far as I am acquainted with the two engines, I consider the rotary the most simple in its construction and application to mechanical purposes, and I think is kept in order with the least expense. With the experience I have with the two engines, I should prefer the rotary for any mechanical purposes whatever. "Respectfully yours,

"NORRIS FELT.

"Elam Lynds & Son."

---

[From the New-England Farmer.]

## MANUFACTURE OF AXES BY NEW MODES.

Mr. Editor: If you think it an object, as I do, to show the ingenuity of Yankees in competing with foreign nations by their inventions and labor-saving machines, the following is at your service. It will afford new evidence of the onward march of improvement. WILLIAM KENRICK.

Being lately at Douglas, Mass., I was invited by my friend, Griffin Clark, Esq. of that place, to visit the Manufactory of Axes, belonging to Messrs. Hunt & Co. At this establishment, about 500 axes and hatchets are manufactured in a day, of all descriptions, and of the most beautiful and perfect workmanship, and chiefly by a new mode. Besides adzes, and a variety of other species of edge tools, I noticed the Pittsburg broad-axe; it is not deep, but the broadest of all I have ever seen; the edge straight, and about sixteen inches in its width; its form resembles the ship-carpenter's axe. The Kentucky axes differ from our chopping axes, only in being heavier, and having a very long bit. The chopping axes and all of larger size are formed in the usual way, by doubling the iron; but all of a smaller description are formed by a new and more expeditious mode. Bars of cold iron, about an inch thick and four inches wide, more or less, according to the size of the intended axe, or hatchet, are cut into suitable lengths with ponderous shears.

These pieces being cast into the forge and brought to the required heat, are cleft at one end, and into this cleft a tongue of cast steel is inserted; then being again heated, the complete union of the iron and steel is effected with the hammer. These being subjected anew to the fire, are laid on edge in a mould, and a single and powerful blow, or pressure of an engine, completes the profile of the small broad-axe or hatchet, and this blow being repeated a second time, renders the outline still more perfect. They are next transferred to another engine, furnished with a die; in this the axe is laid, and a heavy weight of iron, similar in size to those employed in driving piles, being drawn up suddenly by water power, completes the form of the axe by its fall.

Another engine is about going into use, which will give to the rough and oblong section of a bar of iron the form of a perfect and beautiful axe or hatchet at a single and instantaneous operation. Thus are these instruments formed; but the eye for the insertion of the handle is made by boring through the cold and solid iron. The axe being fixed in a firm position above, a vertical drill of species of auger perforates them from below. This auger has a threefold motion: First, a revolving motion on its own centre; Second, it moves in an orbit, which is that of a very eccentric ellipsis, corresponding with the form of the eye; Third, a vertical or upward motion at intervals, and at each time it has completed a revolution in its orbit.

An axe is bored in about twenty minutes; and one man will attend to twenty-five augers or axes; and another man is sufficient to sharpen the drills or instruments for the same.

Respectfully, your friend and obedient servant, W. K.

[From the London Mechanics' Magazine.]

***Gun with a Revolving Breech — Simple Mode of Increasing the Tractive Power on Roads—Relief-wheels for Common Road Steam-Carriages.***

Sir: The following matters are submitted for insertion in your truly valuable publication, should you deem them deserving a place in it.

I am, Sir, your obedient servant,

ROBERT CAREY,
Rector of Donoughmore.

1. The first invention to which I would call your attention is a gun with a revolving breech, containing seven chambers, brought in succession into position, by the single movement of elevating the hammer. I sent it to the exhibition of Irish Manufactures and Inventions, held at the Royal Dublin Society, in May, 1834, where it still remains. It is thus described in the Dublin Evening Packet, of the 22d of May: "In our last notice of this exhibition we described a gun with a revolving breech, capable of being discharged seven successive times within a space of from 25 to 30 seconds; we have just learned that the inventor is a clergyman, living in the county of Tipperary, and that the gun was manufactured in the town of Clonmell." I would here observe, that it has been suggested to me by military persons that the principle of the above invention would apply with great effect to cannon.*

2. I would in the next place submit a project directed to the increase of power applied to draught.

The means which I would suggest for the attainment of this object are a new formation of road, by which wheels *of any diameter*, that it may be found convenient to use, are rendered applicable to draught, without destroying the proper direction of the line of traction. I propose to give what I shall term the power-road (or that on which the power moves, whether it be steam or otherwise,) an elevation above the waggon-road (or that on which the train of carriages moves,) proportioned to the magnitude of the wheels which it may be found most advantageous to use. Assuming that the power attained from the application of wheels of different magnitudes, moving on ordinary roads, varies in the direct ratio of their semi-diameters, an elevation of three feet in the power-road would double the power, inasmuch as it would render applicable wheels of double the diameter that would apply with effect on an ordinary road. I am aware the advantage obtained on a railroad, by the application of this principle, is not so considerable; I calculate that the comparative powers of wheels of different magnitude, on a railraad, vary as the square roots of the semi-diameter of the wheels. An obvious advantage, exclusive of the increase of power, resulting from the above construction of road, would be its rendering an upset impossible.

3. The next project I would submit is directed to obviate an inconvenience (much dwelt on in a late number of your publication,) resulting to carriages impelled by steam, and *moving on common turnpike-roads*, from the inequalities or ruts of unavoidable occasional occurrence in roads composed of ordinary materials. I would have each axle furnished with two wheels additional, and exterior to the main wheels, and *of somewhat smaller diameter*. These additional I shall term relief-wheels. The effect of this contrivance must, I conceive it is obvious, be, to relieve the carriage from any shock from inequalities in the road, *except* when a depression or rut presents itself *at the same moment* to a main wheel and corresponding relief-wheel, which, it is obvious, except on roads *in total disrepair*, would be of extremely rare occurrence.

I beg to apologise for the extent to which this communication reaches, and am, Sir, your obedient servant,

R. C.

Donoughmore Glebe, Clonmell,
25th Jan., 1835.

---

THE STEAM CARRIAGE COMPANY OF SCOTLAND have brought an action of damages against the Trustees of the turnpike road between Glasgow and Paisley, for having compelled them to give up running on that road (after doing so with great success for several weeks continuously) by "wantonly, wrongfully, and maliciously accumulating masses of

---

* We should be glad to receive from our worthy correspondent a more particular description of this ingenious invention. A drawing is also very desirable.—[ED. M. M.]

metal, stones, and rubbish, on the aforesaid road, in order to create such annoyance, hazard, and obstruction, as might impede, overturn, or destroy the steam-coaches belonging to the pursuers (plaintiffs)." The summons or declaration states, that the hostility of the defendants was carried to such a pitch, that they made the road not only impassable for steam-carriages, but nearly so for carriages of every description. "The ordinary horse-carriages running upon the road were also much injured, and the heavy carts and waggons usually plying between Glasgow and Paisley were obliged to desert the said road, and to go round by a different and a longer route." The damages are laid at £30,000!

---

[From the Journal of the Franklin Institute.]

## DETECTION OF ADULTERATIONS IN FLOUR.

M. Dubuc, senior, of Rouen, has applied himself with success to the detection of farinaceous mixtures in wheaten flour. The principal substances with which flour is adulterated are potato starch, a fecula; beans, barley, chalk, plaster of Paris, &c. An extract from his memoir is published in the last Bulletin of the Society of Encouragement, from which the following is taken.

There are two methods of detecting adulterated flour, mechanical and chemical. In France the adulteration is principally with potato starch, as it renders the bread whiter and heavier. If there be more than ten per cent. of potato starch, it may be detected by the naked eye, or with the aid of a magnifying glass; the fecula is whiter, the particles are angular, and reflect the rays of light, like minute crystals. To render the discovery more easy, M. Dubuc dries the suspected flour in a sand bath, at 100° to 110° of Fahrenheit; and then, with a good magnifying glass, so small an adulteration as five per cent. may easily be detected.

But if the miller has been cunning enough to grind the potato starch with the wheat, other means of detection must be had recourse to.

The first is, from the great difference between the specific gravity of wheat flour and potato starch.

The second is, that flour contains a certain per centage of *gluten*, and the starch does not contain an atom of gluten.

*First Method.*—A vessel that will contain one pound of flour, gently pressed down, will contain a pound and a half of *fecula;* from these data the relative portions of flour and fecula, in any parcel of flour, may be easily ascertained very near the truth.

*Second Method.*—The best flour contains about twenty per cent. of gluten, and, as we have stated, the starch not an atom.

*Experiment.*—Take five ounces of pure wheat flour, and two ounces and a half of warm water; mix and work it well for about ten minutes; the paste will be firm and elastic. Let a little warm water fall continually upon it, while you continue to knead it; by this means, all the starch and saccharine mucilage will be extracted. The operation is finished when the water flowing from it ceases to be white; what remains is gluten, the weight of which will be about one ounce. If the flour be adulterated, the paste will be more liquid, less cohesive, and less elastic, and an intelligent baker will soon be able to discover to what extent the flour has been adulterated, from the appearance of the paste, &c.

Such are the mechanical means that may be employed with success.

*Employment of Chemical Agents to discover Frauds in Flour.*—It will be well to bear in mind, that wheat flour is an animalized azotic matter, (*matiere animalise azotee,*) and that, on the contrary, fecula, or the starch extracted, pure from cereals, is entirely of a vegetable nature: from this difference results the varied effects of the re-agents employed.

The three chemical tests which have been found best for general use, are nitric and muriatic acid, and the liquid nitrate of mercury, (*deuto nitrate.*) Their chemical effects on flour and fecula are as follows:

1. Nitric acid has the property of coloring wheat flour of a fine orange yellow, whereas it neither affects the color of fecula nor starch.

2. Pure muriatic acid colors good wheat flour of a deep violet, but dissolves fecula and starch, and forms with it a light, colorless, viscous fluid, decomposable by alkalies.

*Experiments with Nitric Acid of* 40°.—Take 100 grains of pure wheat flour, pour on it 100 grains of nitric acid, (aqua fortis,) in a small earthen or China cup, stirring it with a glass tube, it will heat a little, and in a few hours it will change color from yellow to a fine orange color.

Take 100 grains of fecula, and pour on it 100 grains of nitric acid; heat it in every respect the same as above, but no caloric will be evolved, and the mixture will not change color.

Take of flour 80 grains, and of fecula 20 grains, and of acid 100 grains; mix well; the color will now be much paler, and of a light citron color. Take 50 grains of flour, and 50 grains of fecula, and 100 grains of acid; mix well; the color is now much paler than before, so that, with a little practice, the quantity of fecula may be detected by the greater or less intensity of colors.

*Experiments with Muriatic Acid of* 21 *Degrees of Strength.*—Take of wheat flour and acid, each 100 grains; mix well; the color will become at first red, then violet, and finish by becoming of a beautiful indigo color. This operation is accelerated if a gentle heat be applied.

Take 100 grains of fecula, and 100 grains of acid; the mixture is at first of the consistency of paste, and then becomes liquid; the fecula is dissolved, and the solution *colorless.*

On varying the proportions of flour and fecula, we shall soon be able to ascertain the quantity of fecula in a sample of suspected flour.

*Experiment in the Liquid Nitrate of Mercury.*—Take of flour and nitrate each 100 grains; mix well with a glass tube or rod. The paste will at first be of a pale citron, then reddish, and in three hours will become a full red. The color is permanent.

Take 100 grains each of fecula and nitrate; they will not combine, nor will the color of the fecula or starch be acted upon.

By mixing flour and fecula in different proportions, and observing the colors, we may soon be able to detect the proportions in which flour is adulterated by fecula or starch.

It may also be observed, that fecula absorbs less water than flour, which affords a ready means of detection.

The adulteration with bean or pea flour may be detected by pouring boiling water upon it, which developes the peculiar smell of these two substances.

We may add, that the adulteration with chalk, or gypsum, may be detected by pouring a diluted acid on the suspected flour, as an effervescence will take place, and carbonic acid gas be disengaged.

---

[From the London Mechanics' Magazine.]

## LONDON FIRES IN 1834.

"The ascending flames * * *
Spire with a bitter and severe delight."
[Count Julian.]

"Thanks!
Nor Hall, nor Abbey, gorged the glutton flame:
But scarce less piteous, a tremendous blaze
From domes, to Freedom and our country dear—
From walls wherein the British Senate set—
Rose towards heaven majestic — and anon,
As with a magic haste, shore, bridge, and street,
Were thronged with living masses, all a-glare;
And the red river, as on gala days,
Became a strand of life!" [Mirror.]

Dear Sir: The commencement of another year affords me an opportunity of recording, in your pages, some particulars concerning the calamities of the past.

Although the aggregate number of fires for the year just ended does not greatly exceed that of 1833, the amount of property destroyed has been much greater, from the circumstance of many of the fires occurring in the largest class of buildings, such as extensive warehouses, or manufactories, and the like.

The fire-offices have had many heavy claims made upon their funds during the last twelve months, but I could sincerely wish that many more of the unfortunate sufferers by fire had been able to call upon these valuable establishments to make good their respective losses. It is much to be regretted, that so many persons neglect to avail themselves of the highly important advantages afforded by fire insurance; that the number of such persons is considerable. however, daily experience too clearly shows.

During the past year there have been, in London and the suburbs, six hundred and fifty-one alarms of fire, as set forth in the annexed table.

| MONTHS. | Number of Fires. | Number of Fires attended by loss of life. | Number of lives lost. | Alarms arising from Fires in chimneys.* | False Alarms. |
|---|---|---|---|---|---|
| January . . . . | 32 | 1 | 1 | 5 | 5 |
| February . . . | 40 | 1 | 1 | 12 | 4 |
| March. . . . . | 37 | 1 | 1 | 11 | 3 |
| April . . . . | 27 | 1 | 1 | 13 | 7 |
| May . . . . . | 37 | – | – | 7 | 6 |
| June . . . . | 37 | – | – | 12 | 1 |
| July . . . . . | 44 | – | – | 5 | 4 |
| August . . . . | 49 | – | – | 5 | 7 |
| September . . . | 40 | – | – | 7 | 5 |
| October . . . | 40 | – | – | 15 | 11 |
| November . . . | 56 | 1 | 3 | 6 | 6 |
| December . . . | 43 | – | – | 8 | 4 |
| | 482 | 5 | 7 | 106 | 63 |

Of the buildings in which the above fires took place there have been—consumed, 28 ; seriously damaged, 116 ; slightly damaged, 338 ; total, 482. Chimneys on fire, 106 ; false alarms, 63 ; making the total number of calls, 651.

By comparing the foregoing with last year's report of London fires (vol. xx. p. 264,) it will be seen that the numbers of the *consumed*, and *seriously damaged*, are smaller than in the year preceding, which is a striking proof of the success that has attended the exertions of the firemen.

Of the twenty-eight wholly consumed, it may be observed, that seven were very old buildings, chiefly built of wood, and otherwise offering great facility for the rapid spread of fire. Seven occurred in buildings filled with such highly inflammable materials as to render it next to impossible to extinguish the fire, and left the firemen no chance of doing more than preserving the adjoining buildings. Six of the premises were so small as to be nearly destroyed before any alarm could be given at the engine stations. Four of the fires were so far distant as to be quite beyond the reach of timely assistance from town. Four were consumed in consequence of want of water ; and I know full well, that had a good supply of water always been at hand, several of the fires which swell the list of *serious* accidents, would have appeared in the next line as *slight* ones.

* This does not include calls to chimneys known at the time to be such, but only those that were represented as bad fires, and attended accordingly.

The following table exhibits the manner in which the fires have been distributed throughout the day and night.

| Hours. | A. M. | P. M. | Hours. | A. M. | P. M. |
|---|---|---|---|---|---|
| First . . . | 29 | 13 | Seventh . . | 8 | 26 |
| Second. . . | 19 | 10 | Eighth . . . | 8 | 34 |
| Third. . . | 23 | 11 | Ninth. . . | 13 | 48 |
| Fourth . . . | 14 | 12 | Tenth . . . | 8 | 47 |
| Fifth . . | 9 | 15 | Eleventh. . | 18 | 45 |
| Sixth . . | 11 | 16 | Twelfth . . | 19 | 26 |

The daily distribution has been,—Sunday, 70 ; Monday, 68 ; Tuesday, 57 ; Wednesday, 78 ; Thursday, 84 ; Friday, 59 ; Saturday, 66.

The following list shows the nature of the occupation of the different premises where the foregoing fires occurred :

Apothecaries 2, bakers 14, barge-builders 1, basket-makers 1, booksellers, binders, and stationers, 7, brokers 3, cabinet-makers 1, carpenters 19, chandlers 2, chemists 4, church 1, chocolate-maker 1, cigar-maker 1, coach-makers 4, coffee-roaster 1, coffee-shops 6, confectioners 2, corn mill 1, corn-chandlers 2, color-makers 2, distillers 3, do. (illicit) 2, dyers 2, eating-houses 5, feather-dresser 1, firework-makers 2, farms 2, brass and iron founders 2, gas-works 2, glass-blowers (illicit) 2, glass and emery paper-maker 1, glue-boiler 1, grocers 3, gunpowder-dealer 1, haberdashers, milliners, &c. 4, hat-makers 3, hemp and flax merchant 1, hotels 7, India-rubber workers 2, lamp-black makers 2, linen-drapers and mercers 4, lodging-houses 33, maltster 1, musical instrument-maker 1, oil and colormen 2, oil and pickle-merchant 1, oil-refiner 1, paper-stainer 1, pawnbroker 1, perfume manufacturing 1, pitch-maker 1, printers 4, prison 1, private dwellings 183, public buildings 3, rag-merchant 1, saw-mill 1, ships 6, ship-builders 3, ship-breakers 1, ship-chandlers 2, silk-weavers 3, shops (retail) 33, stables 7, steamboat 1, sugar-refiners 3, tallow and wax chandlers 2, tinmen and braziers 6, turpentine-maker 1, tanner 1, theatre 1, unoccupied houses 7, under repair 3, upholsterer 1, victualler's (licensed) 16, vinegar-maker 1, wadding-maker 1, warehouses 12, water-proof canvas-maker 1, wine and spirit merchants 4, workhouses 3. Total, 482.

In the foregoing classification, care has been taken to distinguish between the fires that occurred in that portion of the

building devoted to the purposes of trade or manufacture, and those that have originated in and damaged the dwelling apartments only, by placing the latter under the respective heads of private dwellings or lodging houses, so that a tolerably fair estimate may be formed from this list, of the relative liability of particular trades, &c., to accident from fire.

The following is an epitome of the causes which are supposed to have led to these fires; but this point it is often exceedingly difficult, and sometimes altogether impossible, clearly to determine.

There appear to have been caused by accidents of various kinds, 40; do. sundry, with candles, 34; do. from candles igniting bed or window curtains, 112; do. from gas, 25; do. from gunpowder, 3; do. from pitch and turpentine, 9; drunkenness, 2; flues and chimneys, defective, foul, overheated, 65; fumigation, incautious, 3; furnaces, overheated, &c., 11; heating of hay, 1; do. lime, 3; do. tan, 1; loose shavings igniting, 6; manufactures, application of fire heat to processes of, 15; reading in bed, 3; stoves, defective setting, overheating, &c., 20; tobacco, smoking of, 6; wilful, 9; unknown, 114. Total, 482.

It is matter of observation, that parcular classes of persons are liable to accidental fires from corresponding causes; thus bakers are very frequently endangered from foul flues, or by the oven being overheated. Linen-drapers and others are continually meeting with accidents from the articles of light fabric in their windows being ignited by the gas.

In private dwellings, candles are often incautiously placed so near as to come in contact with bed and window curtains,—to which cause no fewer than one hundred and twelve fires were clearly attributable, during the last twelve months.

The defective construction, and imperfect cleansing, of flues and chimneys still proves a fruitful source of danger; during the last year sixty-five accidents of this description would have been attended with serious consequences, but for the timely aid of the firemen. The number of chimneys on fire in the metropolis varies from one hundred to one hundred and fifty per month!

Wine-merchants and others run imminent risks from the common, but highly improper, practice of entering vaults and cellars with candles or other exposed light, which dropped among the straw, with which such places abound, causes immediate inflammation. A lantern, or other *enclosed light*, should alone be suffered to enter any places where straw, shavings, or such like, are scattered about.

Wine and other cellars usually consist of brick arched vaults, having but one place of entrance, and therefore but imperfectly ventilated at any time; in the event of a fire taking place, the smoke which arises is of the most noisome description, and from this cause the firemen experience the utmost difficulty in getting at or extinguishing fires in such places. Some of the most troublesome fires have been of this description.

It is with much pain that I record the loss of seven lives by fire last year; it is some alleviation, however, to know that this is the smallest number reported for a great length of time. Three of the unfortunate individuals perished in the flames of their burning habitations, and one in endeavoring to escape therefrom. The remaining three lost their lives from their wearing apparel taking fire. Besides these, an elderly lady was burnt to death at Hammersmith on the 18th of November, but this fire not having been attended by the London firemen, it is not included in the foregoing report.

Several of the last year's fires were of the most terrific description, and much larger than had before occurred, since the formation of the General Fire-Engine Establishment by the United Insurance Companies. The first of these fires broke out in the evening of February the 7th, at Mr. Banks' sugar-refinery in Osborne street, Whitechapel. The metropolis was at the time enveloped in a fog of the most dense description; when I reached the spot, a few minutes after eight o'clock, the lofty building was one mass of brilliant flame. The several engines were brought up with great promptitude, and most skilfully directed. Although the square pile of building, in which the fire originated, had got so

thoroughly inflamed as to be consumed, some other buildings in immediate connexion with it, containing a steam-engine and other valuable property, were saved; the fire being stopped in the passages of communication, in the most masterly manner. While the fire was at its highest, a policeman arrived with intelligence of another bad fire at Poplar; two engines were immediately spared, and galloped off to afford the required assistance.

Another alarming fire broke out at two o'clock in the morning of June 16, at Mr. Price's, in Bishopsgate street, and consumed that and adjoining houses; the buildings were all very old and full of dry wood-work, and so intimately connected, that it was for some time impossible to stop the progress of the flames; ultimately, however, the perseverance and intrepidity of the firemen were successful, the fire being fairly beaten in the houses on either side to which it had extended. On the 11th of September, another sugar-refiner's was destroyed by fire, viz., that belonging to Messrs. Watson and Co., in Pump-court, Ratcliff cross. When the fire was first discovered, it had got so great a head as to render it impossible to save the premises; by great exertions, however, the fire was prevented from extending beyond the building in which it originated. On Thursday, October the 9th, at noon, a fire occurred at Messrs. Powell and Co.'s oil and pickle warehouse, in Laurence Pountney lane, from a candle dropped in the cellar; the engines were quickly on the sp t, and soon in full work, but for reasons already adverted to, the fire could not be got at; the smoke, which was of the most intolerable description, issued in great abundance, and for a time kept the firemen at bay; after some time an entrance was partially effected, and the water was thrown more advantageously. For five hours and a half all the engines in attendance (about ten) worked into the building incessantly. The cellar was partly filled, and every floor covered, with water, to the depth of several inches, notwithstanding which, at about half past five o'clock in the evening, the flames suddenly burst up through the whole building, with a vehemence that surprised all who saw it; the firemen were for a moment astounded, but they soon rallied, and poured in their streams from various well chosen positions, with such good effect that the triumph of the flames was short.

All other fires sink into total insignificance, however, compared with the calamitous conflagration which destroyed both houses of Parliament. This fire of fires broke out at twenty minutes before seven o'clock on Thursday evening, the 16th of October, when an immense body of flame suddenly burst forth from the lower end of the House of Lords.

I was called to the scene of action about seven o'clock, from observing a deep crimson hue in the sky, which pretty well indicated both the situation and magnitude of the conflagration, although there was a strong twilight at the time, and the moon was shining with great brilliancy. On arriving in Old Palace yard, about half-past seven, I found the House of Lords, and suite of rooms facing the Yard, enveloped in one vivid mass of flame; the House of Commons soon after ignited; and the fire, fanned by a strong south-west wind, gradually extended to the Commons' committee-room and waiting-room, &c.

Several engines had arrived, and were stationed by their foremen in Old Palace yard, as was supposed, under the idea "that they could never be wrong when they laid their engines abroadside the burning buildings." The water, though at first rather scant, was afterwards tolerably plentiful; the engines were well manned, and worked with great spirit, but their powers were for some time sadly misapplied.

Several of the firemen mounted the portico in front of the building, pouring their jets of water upon parts that were in a state of most intense combustion, while it was evident enough to all but themselves, that they were exposing themselves to great danger without a possibility of being useful.

Several engines belonging to the London Fire Establishment were in full work by half past seven, when that from Watling street station arrived, with Mr. Braidwood, the superintendent, who immediately commenced a survey of the fire, for the purpose of placing the men and engines under his command in the

most advantageous positions. Mr. Braidwood was not long in forming his "line of battle," and all the force of the combined Establishment present became actively engaged with their elemental foe.

Soon after eight o'clock, the flames were advancing towards the square turret at the corner of St. Margaret street, at the uppermost window of which several persons appeared, and in the most earnest manner implored assistance; two or three ladders were at hand, but they all proved too short to reach the window; a call was immediately raised for the brigade ladders, and it was most promptly answered. Several lengths of scaling ladders were instantly brought to the spot, and the two first ladders were scarcely put together when Mr. Braidwood came up. Length after length was added, until six had formed a ladder of the requisite height. The joining and raising of six ladders is a work of some minutes; while it was steadily proceeding, the most intense anxiety was depicted on the countenances of all the spectators, and when at length the ladder reached the window where the unfortunate persons were collected, a simultaneous shout of applause burst from the assembled throng. The persons thus rescued proved to be Lord F. Fitzclarence and some soldiers; his lordship was the last to descend.

The promptitude with which the ladders were brought up, and the steady masterly style in which they were elevated, reflect much credit on Messrs. Adams, Carter, Elderton, Moore, and George and Henry Rose, who, under the direction and with the assistance of Mr. Braidwood, effected this movement. These ladders were very extensively employed at this fire; their construction has been fully described at p. 184 of your 22d volume*.

Long before eight o'clock great apprehensions were felt for the safety of Westminster-hall, and it at length became evident that the fire had extended so much in that direction as to place it in the utmost jeopardy.

To effect the preservation of this venerable building appeared to be a strong and universal feeling, and the most extraordinary efforts were made on its behalf. Mr. George Colf (late foreman of the Alliance), of the Farringdon street station, ran his engine into the body of the Hall, and was quickly followed by Mr. E. Bourne, of the Waterloo-road station; two other engines, placed in New Palace Yard, supplied the former with water.

The firemen ascended by means of a ladder to a lead flat outside the great window of the Hall, and kept up a continued deluge upon the flames that confronted them.

Several noblemen present being extremely urgent for the preservation of the finely-carved King's Arms, it was lowered from its place, and lodged in safety, by W. Free and T. Colcomb.

Perhaps the fire experienced the most determined resistance and most decisive check at this point. The public press, speaking of the conduct of the firemen, observed, "their exertions were all that could be expected from zeal and manliness."

"Distinctlier there
We saw and heard with what hydraulic skill
The dreadless fireman combatted the flame,
Unheedful he of peril. There we saw
The fragile rafters blazing at his feet;
And the hot lead on his broad helmet fall
Like rain-drops dripping."

A distinguished gentleman, who was present for a length of time, writes as follows: "I gave all my attention to the Hall, and it is due from me, who was almost constantly present on the lead flat outside of the great southern window of the Hall, from a little after seven o'clock until half-past ten, to state, that the preservation of this, our country's pride, is solely attributable to the unrelaxing and brave exertions of two men of the names of Free and Solomons, belonging to the London Fire Establishment, whose engine was stationed in the body of the Hall; and to two other men, of the names of West and Williams, belonging to the County Fire Office, whose engine was stationed in Palace-yard, and made to play on the spot I have mentioned, by means of the hose being conveyed to the Hall through the narrow passage that leads into the Yard under the south-western corner of the Hall." Wm. Free* had his helmet burnt upon

* See p. 132, current volume, of this Magazine.

* Who formerly belonged to the London Assurance Corporation.

his head, and his coat covered with melted lead; his hands were also much burnt, but he most heroically kept his post, although at the time much indisposed from a violent cold, caught at Messrs. Powell's fire, in Laurence Pountney lane, on the preceding Thursday; he ultimately suffered a severe illness in consequence of his exertions, from which he is only just recovered. Josh. Solomon, his comrade, received a severe blow on the head from some falling timber, and was carried to the hospital much injured. Another intrepid fireman belonging to the establishment, John Hambleton, is still confined to the hospital, where he has been suffering with exemplary patience and fortitude the consequences of a double compound fracture of his leg, and the preservation of his life reflects the highest credit on his medical attendants. His brother, Edward Hambleton, was with him at the time of the accident, and had a most miraculous escape.

I most sincerely hope that the extraordinary exertions of these individuals will not be suffered to go wholly unrewarded; a promise of future recompense was made at the time, by the gentleman whose words I have quoted, and I hope the circumstance will not entirely escape his memory.

While some portion of the men belonging to the Fire Establishment were thus occupied in effecting the preservation of the Hall, a great number were engaged with equal zeal at various other points. The courts of law, which were for some time in imminent danger, were wholly preserved. The fire attained a considerable head in the Speaker's house, and nearly half of it was destroyed; but the firemen were eventually victorious. At a very early period of the evening, three engines were placed at the corner of Abingdon street, for the purpose of saving, if possible, the library and committee rooms of the Lords, and the Parliament offices adjoining; this was a work of much difficulty, but it was happily accomplished.

Not to occupy more of your valuable space by entering into further detail, I may briefly state, that the conduct of the firemen belonging to the united offices was such as to merit the highest praise: the Establishment mustered twelve engines (exclusive of the floating engine) and sixty-four men. There were also present about eighteen parochial, fire-office, and other engines, acting independently of each other, under their respective foremen, whose mismanagement created considerable confusion.

This circumstance gave rise to a very general feeling among those assembled, and one that was somewhat strongly expressed by the public prints,—that "for the first two hours of the fire, although there were engines enough, and the men were actuated by a zeal and hardihood which cannot be too much commended, yet there was scarcely such a thing as systematized command or intelligent direction amongst them." "In fact, while the individual exertions of the firemen were most admirable, their general management was execrably bad; subjected as it was on so important an occasion to full exposure, it would have been most ludicrous, but that it seemed fraught with disastrous consequences."

It was unfortunate, but wholly unavoidable, that at the fire in question the evils of the old independent mode of proceeding were most strikingly evident, while the great and important advantages of the co-operative system were not so apparent. This arose from the circumstance of the men belonging to the United Establishment combatting the flames at close quarters, and therefore at points not visible to the bulk of the spectators. All those persons, however, who like myself had an opportunity of observing the exertions made simultaneously at various points, will bear ample testimony to the judicious and zealous exertions of the firemen, and the skill by which they were directed.

There were many circumstances that combined to render the suppression of this fire exceedingly difficult; and it is quite certain, that but for the extraordinary efforts of Mr. Braidwood and the men under his command, the fire would have extended much farther; in fact, it is difficult to say where it would have ended.

It is but justice to state, that several of the engines engaged gave great assistance to the combined force. The Norwich Union Society's engine, and one of Bramah's construction, brought by the

Royal Horse Guards Blue, were admirably worked and skilfully directed.

The London Fire Establishment continues steadily to improve, and its advantages begin to be better understood, and more fully appreciated, by the public at large. The men have on every occasion shown the greatest alacrity and zeal, and have conducted themselves in a most praiseworthy manner. The skilful management of Mr. Braidwood has given such effect to the force under his command, as to render far more efficient protection to lives and property than could possibly be accomplished by the more numerous independent bodies on whom this duty formerly devolved.

But it is matter of extreme regret, and reflects no small disgrace on those concerned, that this protection should be permitted to depend entirely on the spirit and enterprise of a few trading companies! Such, however, is the fact.

The *sappeurs pompiers* of Paris, and the continental fire associations, have long been celebrated for the success of their systematic exertions; in Edinburgh, in Manchester, and other provincial towns, the inhabitants are under the protection of a well organized and efficient fire police; but in this, the first metropolis in the world, we are altogether destitute of such a provision. It is to be hoped that the Legislature will shortly correct this crying evil, and by attaching the parochial engines (at present worse than useless) to the police force, under one superintendent, render them an efficient body of men, capable of affording most prompt and effectual assistance under every emergency.

How these things are managed by some of our trans-atlantic brethren, may be seen by the following extract from the American Railroad Journal for May 10, 1834:

"*Splendid Fire Engine.*—We do not believe there is in the world a more magnificent thing of this sort than the new engine belonging to the Columbian Company, and which that spirited association have been exhibiting to their fellow citizens, at the engine house in the rear of St. Paul's church. The frame of this elegant machine is of a very superior construction, and the ornamental appointments are of the costliest and most tasteful description. The carving is done in mahogany; but so beautiful is the gilding and bronzing, that it would be taken for solid metal. The plating is superb. The painting is excellent, as well in design as in execution. The motto of the company, '*Actuated by benevolence, impelled by emulation,*' is not only beautifully engraved, but is much truer to the intent, and nearer to the actual character, of our gallant fire companies, than most mottoes are. The back scene, representing the parting of Otwa and Azula, from the course of Talhoosin, is uncommonly fine. In short, the whole work reflects the highest credit, as well to the various artists who have been employed in its construction and decoration, as to the deserving company of young men to whom it belongs.

"The whole existence of such a body as our firemen—volunteers as they are altogether, in arduous, fatiguing, and often perilous duties—seems to us in a high degree characteristic and peculiar. In London the firemen receive regular pay, and are a body apart. In Paris, they are a military corps, *sappeurs et pompiers.* In our American cities, they are young men of all pursuits, who spend time, labor, and money—much money sometimes, as the decorations of the engine above described will prove—for the general good, without any compensation to be named; for the exemption from jury duty, and a portion of taxes, is nothing in comparison with the sacrifices. Yet there is among these volunteers much skill, and probably more emulation than in the paid servants or soldiers of other countries."

The motto of the London Fire Establishment being UTILITY alone, ornament of all kinds has been avoided as superfluous; but formerly the insurance companies' engines were very handsomely adorned. About three months since, Mr. Lott, of Long-acre, constructed a fire engine for the West of England Fire Office at Exeter, which was the most elegant thing of the kind I ever saw, and for workmanship and decoration may very well be put in comparison with the American engine described above.

There can be no doubt that the volunteer principle, as applied to firemen, answers extremely well on the Continent, and in the United States; it might also be successfully adopted in most small

towns in England and elsewhere, especially as incendiary fires are now so prevalent. For large towns, however, and for this metropolis in particular, it is wholly inapplicable, as in such places the expense becomes too great, the services much too arduous, and too frequently required, to be sustained by voluntary exertions. At the same time it should be observed, that although our fire establishment is composed of paid servants, yet these are supported by the *voluntary contributions* of the several insurance companies, who are not in any way *compelled* to maintain such an efficient and expensive establishment, but do so of their own free will. But for the protection thus afforded, London would surpass all other cities in the extent, as it does in the number, of its destructive conflagrations.

I remain, sir, very respectfully yours,

WILLIAM BADDELEY.

10 Wilderness-row, Goswell street, Jan. 31, 1835.

---

[For the Mechanics' Magazine.]

## USEFUL PROBLEMS IN GEOMETRY.

1. To find the length of the arc of a circle.

Rule. Multiply the decimal .01745 by the degrees in the given arc, and the product by the radius of the circle, for the length of the arc.

Example. What is the length of the arc of a circle, the number of degrees being 25, and radius 7?

$.01745 \times 25 \times 7 = 3.05375$, length of arc.

Note. .01745 is found by dividing the circumference by 360° when the radius is 1, i. e. $\frac{6.2831854}{360} = .01745$.

2. To find the length of the cord of an arc of a circle.

What is the length of the cord of an arc of 35° or 70°, whose radius is 10?

In the triangle ABC given, (see fig. 1,) ACB=70°; consequently, CAB, or ABC, will be each 55°.

By Log.—As the angle ABC.55° is to side AC.10, so is angle ACB.70° to side AB—.

By Geometry—1st, $AC^2 - AP^2 = CP^2$

2d, $PD^2 + BP^2 = BD^2$

3d, then $CD - DP = CP$

4th, and $AP^2 + CP^2 = CD^2$ or $AC^2$

5th, $AP^2 + DP = AD^2$ or $DB^2$

Making 5 and 4 equal,

$$PA^2 + CP^2 + PA^2 + DP^2 = CD^2 + BD^2$$

$$CD - DP = CP, \text{ and } CP^2 = CD^2 - AP^2$$

$$4 : 8 :: 8 : 10 + 6$$

$$DP : PA :: PA : CD + CP$$

$$CD - DP = CP$$

$$\text{and } CP^2 = CD^2 - AP$$

$$\frac{PA^2}{PD} = CD + CP$$

$$2CD = \frac{PA^2}{PD} + PD$$

Suppose AC=10

AB=16

DP=4

CP=6

DB=$\sqrt{80}$

It being self-evident that the fourth of the square of a whole number is equal to the square of half that number. Thus,

$$\frac{AB^2}{4} + \frac{CP^2}{\quad} + \frac{AB^2}{4} + \frac{DP}{\quad} = CD + DB^2,$$

and $\frac{AB^2}{2} + \frac{CP^2}{\quad} + \frac{DP^2}{\quad} = CD^2 + BD^2$

$2CP^2 + 2DP^2$.

3. A segment of a circle being given, to find its centre.

1st. Let ABC be the given segment.

Bisect AC at D, and draw BD perpendicular; then draw a line from A to B, and if the angle at B be equal to the angle at A, D is the centre, as in figure 2.

If the angle at A is less than the angle at B, then produce BD, and draw AE, making an angle A equal to B; then E is the centre, as in figure 3.

3. Again: if the angle at A is greater than the angle at B, draw AE, making the angle at A equal to the angle at B; and E is the centre, as in figure 4.

4. Another method: Draw the base AB, and bisect at C; draw CD perpendicular to AB, and draw AD; bisect AD in E; draw EF perpendicular to AD, and where EF intersects CD produced at F is the centre, as in figure 5.

5. Another method: Set the dividers at any convenient distance, and make three centres, A, B, and C; then with one foot in the centres, describe the arches *a b c d*, through the points of intersection, at *a b c d*, draw the lines *a b c d*, and where they intersect at D is the centre, as in figure 6.

Fig. 1.

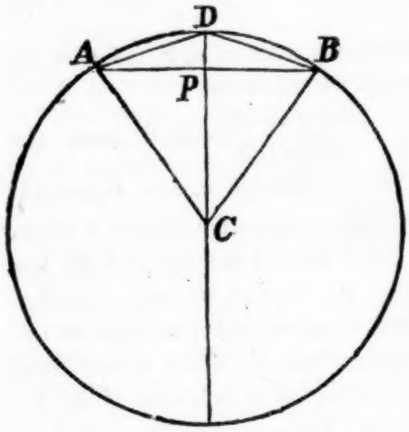



Fig. 2.

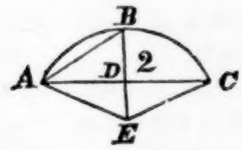



Fig. 3.

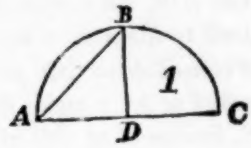



Fig. 4.

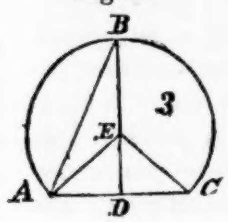



Fig. 5.

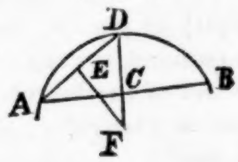



Fig. 6.

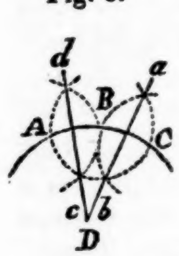



Fig. 7.

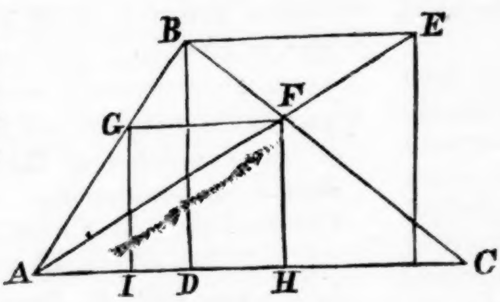



Fig. 8.

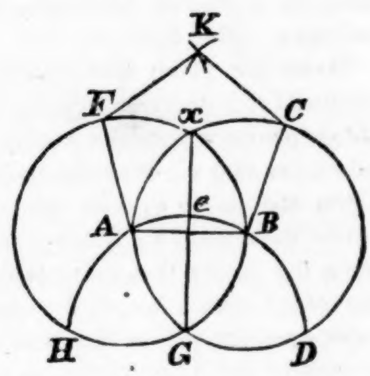



Fig. 9.

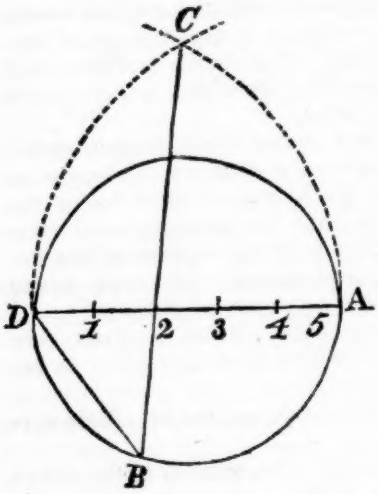



Fig. 10.

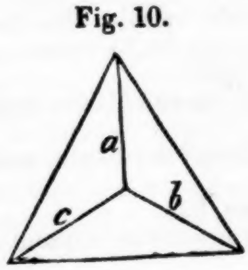
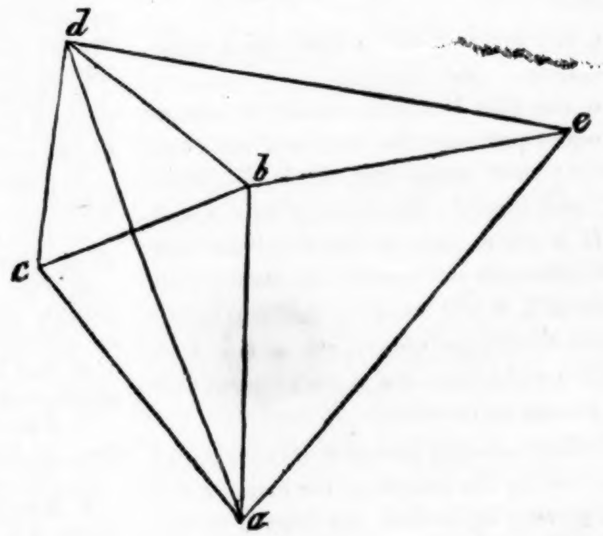



Fig.. 11



4. To inscribe a square in a given triangle. (See fig. 7.)

Let ABC be a triangle, in which it is required to inscribe a square, IGFH.

From B draw BD perpendicular, and BE parallel to AC; make BE equal to BD; join AE, intersecting BC in F, and complete the rectangle IGFH.

This is very useful, many times in carpentry or joinery; for instance, suppose it is required to cut or hew a square stick of timber of the largest extent, out of a stick that is triangular; then this problem will be useful. It matters not what shape the triangle is; it will answer equally well for all kinds of triangles.

5. Upon any given right line, as AB, *to describe* a regular pentagon, or five-sided polygon. (See fig. 8.)

Make the given line *radius*, and upon each end of it describe a circle; and through those points where the circles cross each other, (as at *g x*,) draw the right line, *g e x*. Upon the point *g*, with same *radius*, describe the arch HA *e* BD, and laying a ruler upon the points D *e*, mark where it *crosses* the other circle, as at F; again lay the ruler upon the points H *e*, and mark where it *crosses* the other circle, as at C. Then from the points F and C, (*with the same radius as before*,) describe cross arches, as at K; join the points AF, FK, KC, and CB, with right lines, and they will form the pentagon required, viz.: AF, FK, KC, CB, and BA, and the angles A, B, C, K, and F, are equal.

6. In any given circle, to describe a regular pentagon. (See fig. 9.)

Draw the line DA, and divide it into as many equal parts as the proposed POLYGON has sides; then make the whole diameter *radius*, and describe the two arches CA and CD. If a right line be drawn from the point C, through the second of these equal parts, as at 2, it will assign a point in opposite semi-circles *periphery*, as at B. Join DB with a right line, and it will be the side of the *pentagon* required.

7. To draw an equi-lateral triangle around a point, having the length of the arms, *a b c*, fig. 10, given; or, to find the length of the sides, having said arms given.

Suppose *a*, *b*, and *c*, figure 10, to measure 20, 29, and 30 feet, what is the length of the sides?

Rule. Divide the sum of *a*, *b*, *c*, figure 10, by the square root of three.

Example. $\dfrac{20+29+30}{\sqrt{3}=1.732}=45.6$ feet, the length of side of triangle *a*, *d*, *e*, figure 11.

To draw said triangle: First draw a triangle whose sides shall correspond with the given lengths, 20, 29, and 30, as *a*, *b*, *c*, fig. 11; then form an equi-lateral triangle on the shortest side, as *b*, *c*, *d*; draw a line from *a* to *d*, which is equal to one side of the required triangle; then take the distance from *a* to *d*, and form the equi-lateral triangle, *a*, *d*, *e*; lastly, draw a line from *b* to *c*; then will $b\ d = 20$ feet, $b\ e = 29$ feet, and $b\ a = 30$ feet, as given. S. A.

---

*Report on the Progress and Present State of our Knowledge of Hydraulics as a Branch of Engineering.* By GEORGE RENNIE, Esq., F. R. S., &c. &c. Part I.

[Continued from page 157.]

In the year 1801, M. Eytelwein, a gentleman well known to the public by his translation of M. Dubuat's work into German, (with important additions of his own,) published a valuable compendium of hydraulics, entitled "Handbuch der Mechanik und der Hydraulik," in which he lays down the following rules:

1. That when water flows from a notch made in the side of a dam, its velocity is as the square of the height of the head of the water; that is, that the pressure and consequent height are as the square of the velocity, the proportional velocities being nearly the same as those of Bossut.
2. That the contraction of the fluid vein from a simple orifice in a thin plate is reduced to 0.64.
3. For additional pipes, the co efficient is 0.65.
4. For a conical tube, similar to the curve of contraction, 0.98.
5. For the whole velocity due to the height, the co-efficient by its square must be multiplied by 8.0458.
6. For an orifice, the co-efficient must be multiplied by 7.8.
7. For wide openings in bridges, sluices, &c., by 6.9.
8. For short pipes, 6.6.
9. For openings in sluices without side walls, 5.1.

Of the twenty-four chapters into which

M. Eytelwein's work* is divided, the seventh is the most important. The late Dr. Thomas Young, in commenting upon this chapter, says:

"The simple theorem by which the velocity of a river is determined, appears to be the most valuable of M. Eytelwein's improvements, although the reasoning from which it is deduced is somewhat exceptionable. The friction is nearly as the square of the velocity, not because a number of particles proportional to the velocity is torn asunder in a time proportionally short—for, according to the analogy of solid bodies, no more force is destroyed by friction when the motion is rapid, than when slow—but because, when a body is moving in lines of a given curvature, the deflecting forces are as the squares of the velocities; and the particles of water in contact with the sides and bottom must be deflected, in consequence of the minute irregularities of the surfaces on which they slide, nearly in the same curvilinear path, whatever their velocity may be. At any rate, (he continues,) we may safely set out with this hypothesis, that the principal part of the friction is as the square of the velocity, and the friction is nearly the same at all depths†; for Professor Robison found that the time of oscillation of the fluid in a bent tube was not increased by increasing the pressure against the sides, being nearly the same when the principal part was situated horizontally, as when vertically. The friction will, however, vary, according to the surface of the fluid which is in contact with the solid, in proportion to the whole quantity of the fluid; that is, the friction for any given quantity of water will be as the surface of the bottom and sides of a river directly, and as the whole quantity in the river inversely; or, supposing the whole quantity of water to be spread on a horizontal surface equal to the bottom and sides, the friction is inversely as the height at which the river would then stand, which is called the hydraulic mean depth."‡ It is, therefore, calculated that the velocities will be a mean proportional between the hydraulic mean depth and the fall, or $\frac{11}{10}$ths of the velocity per second.

Professor Robison informs us, that by the experiments of Mr. Watt on a canal eighteen feet wide at the top, seven feet at the bottom, and four feet deep, having a fall of four inches per mile, the velocities were seventeen inches per second at the surface, fourteen inches per second in the middle, and ten inches per second at the bottom, making a mean velocity of fourteen inches per second; then finding the hydraulic mean depth, and dividing the area of the section by the perimeter, we have $\frac{50}{20.6}$, or $29.1\dot{3}$ inches; and the fall in two miles being eight inches, we have $\sqrt{(8 \times 29.13)} = 15.26$, for the mean proportional $\frac{11}{10}$ths, or 13.9 inches, which agrees very nearly with Mr. Watt's velocity.

The Professor has, however, deduced from Dubuat's elaborate theories, 12.568 inches. But this simple theorem applies only to the straight and equable channels of a river. In a curved channel, the theorem becomes more complicated; and, from observations made in the Po, Arno, Rhine, and other rivers, there appears to be no general rule for the decrease of velocity going downwards. M. Eytelwein directs us to deduct, from the superficial velocity, $\frac{1}{130}$ for every foot of the whole depth. Dr. Young thinks $\frac{9}{10}$ths of the superficial velocity sufficient. According to Major Rennell, the windings of the river Ganges, in a length of sixty miles, are so numerous as to reduce the declivity of the bed to four inches per mile, the medium rate of motion being about three miles per hour, so that a mean hydraulic depth of thirty feet, as stated to be $\frac{2}{3}$ds of the velocity per second, will be 4.47 feet, or three miles per hour. Again, the river, when full, has thrice the volume of water in it, and its motion is also accelerated in the proportion of 5 to 3; and, assuming the hydraulic mean depth to be doubled at the time of the inundation, the velocity will be increased in the ratio of 7 to 5; but the inclination of the surface is probably increased also, and consequently produces a further velocity of from 1.4 to 1.7. M. Eytelwein agrees with Gennete,* that a river may absorb the whole of the water of another river, equal in magnitude to itself, without producing any sensible elevation in its surface. This apparent paradox Gennete pretends to prove by experiments, from observing that the Danube absorbs the Inn, and the Rhine the Mayne, rivers; but the author evidently has not attended to the fact, as may be witnessed in the junction of rivers in marshes and fenny countries—the various rivers which run through the Pontine, and other marshes, in Italy, and in Cambridgeshire and Lincolnshire, in this country; hence, the familiar expression of the waters being overridden, is founded in facts continually observed in these districts. We have also the experi-

* See Nicholson's translation of Eytelwein's work.

† See my "Experiments on the Friction and Resistance of Fluids," Philosophical Transactions for 1831.

‡ See Nicholson's Journal for 1802, vol. iii., p. 31.

* Experiences sur le Cours des Fleuves, ou Lettre a un Magistrat Hollandais, par M. Gennete. Paris, 1760.

ments of Brunings, in the "Architecture Hydraulique Generale de Wiebeking," Watmann's "Memoires sur l'Art de construire les Canaux," and Funk "Sur l'Architecture Hydraulique Generale," which are sufficient to determine the co-efficients under different circumstances, from velocities of $\frac{2}{3}$ths to $7\frac{1}{2}$ feet, and of transverse sections, from $^1$ to 19135 square feet. The experiments of Dubuat were made on the canal of Jard, and the river Hayne; those of Brunings, in the Rhine, the Waal, and Ifrel; and those of Watmann, in the drains near Cuxhaven.

M. Eytelwein's paper contains formulæ for the contraction of fluid veins through orifices,* and the resistances of fluids passing through pipes, and beds of canals and rivers, according to the experiments of Couplet, Michelotti, Bossut, Venturi, Dubuat, Watmann, Brunings, Funk, and Bidone.

In the ninth chapter of the "Handbuch," the author has endeavored to simplify, nearly in the same manner as the motion of rivers, the theory of the motion of water in pipes, observing that the head of water may be divided into two parts, one to produce velocity, the other to overcome the friction; and that the height must be as the length and circumference of the section of the pipe directly, or as the diameter, and inversely as the area of the section, or as the square of the diameter.

In the allowance for flexure, the product of its square, multiplied by the sum of the sines of the several angles of inflection, and then by .0038, will give the degree of pressure employed in overcoming the resistance occasioned by the angles, and deducting this height from the height corresponding to the velocity, will give the corrected velocity.†

M. Eytelwein investigates, both theoretically and experimentally, the discharge of water by compound pipes, the motions of jets, and their impulses against plane and oblique surfaces, as in water wheels, in which it is shown that the hydraulic pressure must be twice the weight of the generating column, as deduced from the experiments of Bossut and Langsdorft; and in the case of oblique surfaces, the effect is stated to vary as the square of the sine of the angle of incidence; but for motions in open water, about $\frac{2}{3}$ths of the difference of the sine from the radius must be added to this square.

The author is evidently wrong in calculating upon impulse as forming part of the motion of overshot wheels; but his theory, that the perimeter of a water wheel should move with half the velocity of a given stream, to produce a maximum effect, agrees perfectly with the experiments of Smeaton, and others.*

The author concludes his highly interesting work by examining the effects of air, as far as they relate to hydraulic machines, including its impulse against plane surfaces, on syphons and pumps of different descriptions, horizontal and inclined helices, bucket wheels, throwing wheels, and, lastly, on instruments for measuring the velocity of streams of water. A very detailed account of the work was given in the Journal of the Royal Institution, by the late Dr. Young. But it is due to MM. Dubuat and Prony to state, that M. Eytelwein has exactly followed the steps of these gentlemen, in his "Theory of the Motion of Water in Open Channels."

[*To be continued.*]

* "Recherches sur le Mouvement de l'Eau, en ayant egard a la Contraction qui a lieu au Passage par Divers Orifices, et a la Resistance qui retard le Mouvement, le long des Parois des Vases; par M. Eytelwein."—Memoires de l'Academie de Berlin, 1814 and 1815.

† Hence, if $f$ denote the height due to the friction,

$d =$ the diameter of the pipe,

$a =$ a constant quantity,

we shall have, $f = V^2 \frac{a\,l}{d}$ and $V^2 = \frac{f\,d}{a\,l}$.

But the height employed in overcoming the friction corresponds to the difference between the actual velocity and the actual height; that is, $f = h - \frac{V^2}{b^2}$, where $b$ is the co-efficient for finding the velocity from the height.

Hence we have,

$$V^2 = \frac{b^2\,d\,h - d\,V^2}{a\,b^2\,l} \text{ and } V = \sqrt{\frac{b^2\,d\,h}{a\,b^2\,l + d}}.$$

Now Dubuat found $b$ to be 6.6, and $a\,b^2$ was found to be 0.0211, particularly when the velocity is between six and twenty-four inches per second. Hence we have,

$$V^2 = \frac{43.6\,d\,h}{0.0211\,l + d}, \text{ or } V = 45.5\sqrt{\left(\frac{d\,h}{l + 47\,d}\right)},$$

or more accurately, $V = 50\sqrt{\left(\frac{d\,h}{l + 50\,d}\right)}$

[For the Mechanics' Magazine.]

*Specification of a new and useful improvement in the Art of Casting Friction Bushes, for Block Sheaves, &c., invented by* Lewis Aspinwall, *of Albany, N. Y.*

Be it known that I, Lewis Aspinwall, of Albany, in the county of Albany, and state of New-York, have invented a new and useful improvement in the art of casting *Friction Bushes,* for block sheaves, and for all other purposes for which such bushes are used.

These sheaves have been heretofore

* The author of this paper has made a great many experiments on the maximum effect of water wheels; but the recent experiments of the Franklin Institution, made on a more magnificent scale, and now in the course of trial, eclipse every thing that has yet been effected on this subject. See also Poncelet, "Memoire sur les Rones Hydrauliques," and "Aubes Courbes par dessons, &c." 1827.

cast in sand, or other earth, and finished by turning, drilling, &c., which mode, as the metal of which they are made necessarily requires to be very hard, is comparatively slow and tedious.

Now, the improvement of which I here claim to be the inventor is the casting all parts of said friction bushes, (except the pins and studs, which may be made of wire,) in smooth metallic moulds, in such manner as to need no finishing, by turning or drilling, or by any other operation, after leaving the mould, except clearing them of the gates or sprues, and except putting together. To understand this more fully, it may be proper to state that the common patent friction bush which is now in use consists of a cylindrical box, in the two halves put together latitudinally, each of which halves is open at the end, making, when put together, a cylinder, open at each end, with an inward flange at each end, to contain and steady the rollers, &c., and this hollow cylinder contains six, more or less, friction rollers, which round within said box, leaving the intermediate space in the centre, for the pin, axis, shaft, or gudgeon, on which they are to turn, or which is to turn in them. The whole of the article, then, consists of two similar half-boxes, and of the rollers; each of which rollers is simply a plain cylinder, with a small hole in the centre of each end for steady-pins, together with two flat circular rims, containing the said steady-pins, which two rims are also held together by any convenient number of studs of wire, the ends of which studs are rivetted on the outsides of the said circular plates.

To save the labor, and consequent cost of turning and other work in finishing, I cast the said boxes, cylindrical rollers, and circular plates, in smooth, metallic moulds, nicely fitted together, to suit the form of each article, so that they leave the mould in a state of complete finish, ready to be put together, except as before excepted.

My moulds I make of cast or wrought iron, but they may be made of any other suitable metal; but of whatever metal made, I claim the casting said articles in smooth metallic moulds, so as to need no other subsequent finish than above stated, as my invention, and constituting the improvement herein specified.

The exterior form of the moulds, and modes of putting them together, may be so infinitely varied, and is so much dependent on the fancy of the constructor, as to need no specific description.

---

[From the Journal of the Franklin Institute.]

*Report to the Board of Directors of Bridges, Public Roads, and Mines, upon the Use of Heated Air in the Iron Works of Scotland and England. By* M. Dufrenoy, *Engineer of Mines. Paris,* 1834.

(Continued from page 239.)

WORKS IN THE ENVIRONS OF GLASGOW.

The vicinity of Glasgow is one vast coal region, the first in Great Britain, both in the extent and the thickness of the veins. This coal basin is also very remarkable for the abundance of its iron ore, both imbedded in the argillaceous schist of the region, and in regular veins, often of considerable extent.

The layers of coal in the vicinity of Glasgow, which belong to the lower strata of the coal formation, alternate with beds of mountain limestone, so that in the same locality are often united the coal, the ore, and flux, and often the fire clay used in the construction of the furnaces.

These invaluable advantages are in part compensated by the enormous loss incident to the carbonization of the coal in this locality, as well as by the lightness of the coke produced. From these circumstances, a ton of iron requires at the Glasgow Works for its production, a much larger quantity of fuel than in any district of England.

The employment of the heated air has produced a revolution in the Scotch works, and enabled them to sustain a competition with those of Wales.

*Clyde Iron Works* were, as before stated, the first in which the heated air was tried. The apparatus now in use, (see figures 1 and 2,) is composed of a double row of horizontal pipes, a, a, a, a, 150 feet long. These pipes are nineteen inches in diameter, and one inch and a half thick. The exterior row passes behind the furnace, and enters the other row, dividing the air into two parts; so that the blast is carried equally to each tuyere.

The valves placed at E regulate the distribution of air, and stop either branch when repairs are required.

Fig. 1.

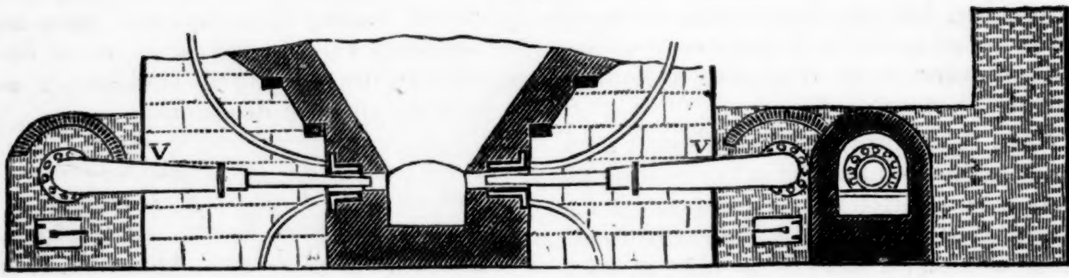



Fig. 2.

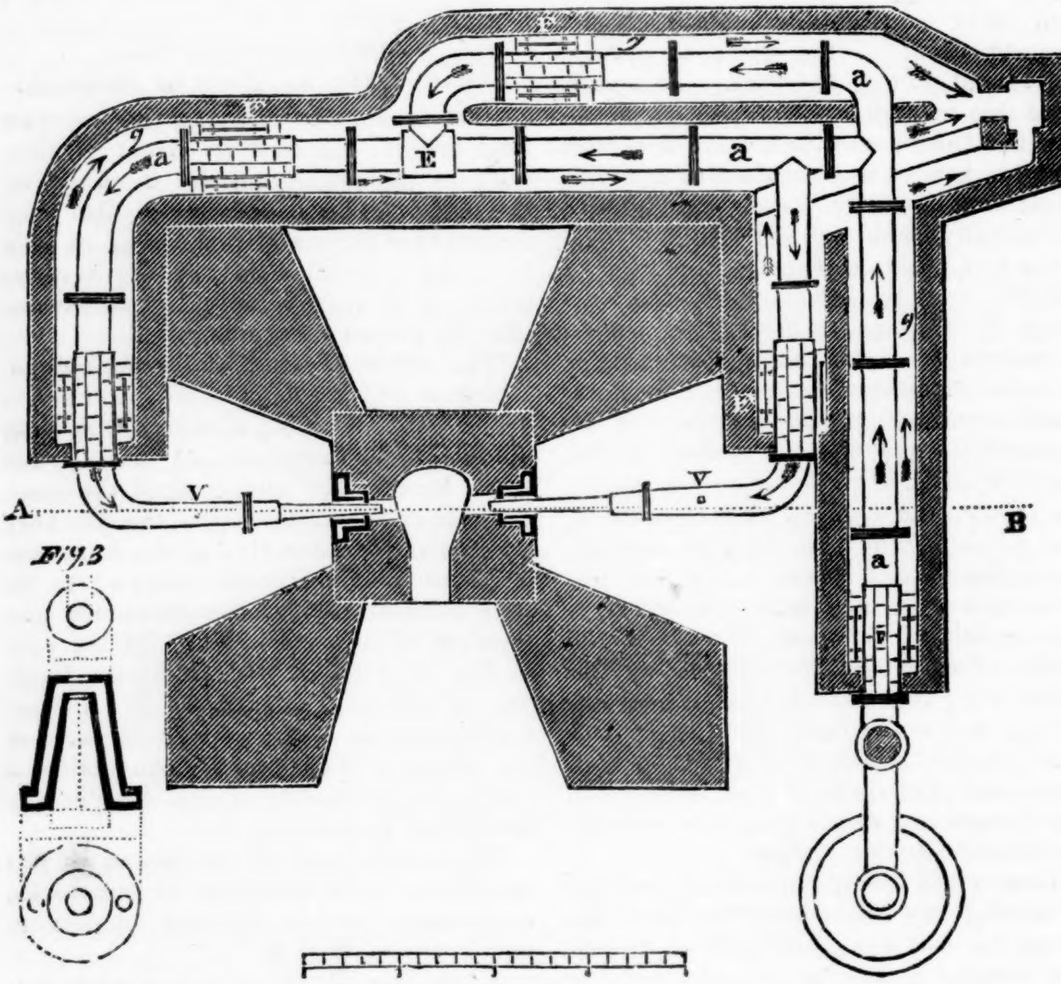



Fig. 3

In the length of 150 feet, the tubes pass through five furnaces, or heaters, F, F, F, F, F, of which two are placed near the tuyeres; so that the air has no time to cool before entering the furnace. Figures 1 and 2 give an exact idea of the form and disposition of the five heating fires; they are connected by a conduit of brick, *g, g, g,* which envelopes the pipes; by this means the flame which escapes from the fireplace circulates about the pipes, and heats their whole length. To preserve the parts of the pipe immediately in contact with the flame, they are encased in fire brick the whole length of the furnace. In the first apparatus of this kind which was constructed, the ends of the pipes were inserted one in the other, having some play to prevent any rupture by expansion; the result was a great loss of air, and the plan was abandoned. Besides, it was remarked that a great waste always took place at the joints of the pipes; so that it was not

sufficient to fasten them with bolts and nuts; the joints were therefore covered with a ring of iron cast on after they were finished. By means of this precaution, the pipes lasted a long time; at the time of my visit, they had been five months in use without repairs.

On the exit pipes are small holes, V, V, by means of which any change of temperature in the air might be ascertained. This precaution is indispensable, because one of the essential conditions in the use of heated air, is, that its temperature be kept uniform—with this apparatus they raised the air to 612° Fahrenheit, which is higher than the melting point of lead.

In the Clyde Works, two of the four furnaces have each an apparatus like the one described, but in the other two there was no room for the extent of pipes, and they are contracted into smaller space, by being doubled upon themselves.

The working of a furnace with heated air requires no particular precaution; the operation is the same as before its introduction, the only difference consisting in the substitution of raw coal for coke. This substitution did not immediately follow the adoption of the new plan; it was some time after, and only when the temperature of the air was raised above the melting point of lead, that the immense benefit of the change was discovered, giving a consequent diminution in the expense of manufacture.

The general idea adopted in Scotland, is, that certain qualities of coal cannot be employed crude, except when the air is highly heated. We have already said that at the Monkland Works, where the air is heated to 460° and 490° Fahr., coke is still used.

The descent of the furnace is very regular—the distances between the charges are nearly equal, the charging being regulated by the space left empty in the throat. The richness of the ore not roasted, varies from 22 to 34 per cent., and the composition of the charges follows this variation. At the time of my visit, the average yield of ore, after roasting, was 44 per cent., and the charges thus composed:

660 lbs. coal,
520 lbs. ore roasted,
100 lbs. lime.

They usually made 40 charges in 24 hours. During the two days that I witnessed the working of the Clyde Works, the number of the charges were,

| | | |
|---|---|---|
| July 4— | from 6, A. M., to 6, P. M., | 38 |
| | from 6, P. M., to 6, A. M., | 39 |
| " 6— | from 6, A. M., to 6, P. M., | 37 |
| | from 6, P. M., to 6, A. M., | 40 |

The yield of the furnace in these four castings, was, 4 t. 8 cwt.; 4 t. 9 cwt.; 4 t. 6 cwt.; 4 t. 12 cwt. Total, 17 t. 15 cwt. for 154 charges; or, 8 t. 17 cwt. 2 qrs. each 24 hours.

This result shows that a ton of iron is produced at an expense of 2 t. 8 cwt. 2 qrs. coal. The consumption of the heating fire is 8 cwt. Total, 2 t. 16 cwt. 2 qrs. per ton of iron.

The castings are made every twelve hours. The metal obtained is usually a mixture of No. 1 and No. 2. That which goes first from the hearth is No. 1. These two varieties of iron are distinguished by the small channels which furrow the surface of the metal while cooling.

The tuyeres are hermetically closed round with clay, and as they cannot resist the elevated temperature to which they are submitted, water tuyeres have been substituted similar to those used in the fineries. The figure 3 represents the tuyeres employed at the Clyde Works; they are of cast iron, and last various lengths of time, averaging five or six months.

The tuyeres are closed in, to prevent the entrance of cold air through the openings. There is no objection to this arrangement, because the air is so hot that no scoria accumulates upon the pipe, and the workmen are never obliged to free the tuyeres. There is a high white heat in this part of the furnace; nevertheless there are scarcely any sparks produced by the oxidation of the iron, and the particles that fall are black in the centre, showing that the metal is still covered with a small layer of melted scoria.

The flame issuing from the furnace is of a bright red, while that from the coke furnace, worked with cold air, is of a yellowish color. This difference of color is as marked as that which exists between the flame of alcohol colored by strontia and by baryta.

The pressure of the blast in the air vessel is two pounds and a half, or five

inches of mercury to the square inch. It is sensibly the same near the tuyeres, only the gauge which indicates it is subject to great oscillations. This pressure was formerly three pounds. The opening of the tuyere is three inches; it was two inches and a half when cold air was used. The quantity of air forced into the furnace is less. The blowing engine, of seventy horse power, served only three furnaces; now it feeds four with ease. From the dimensions of the blowing cylinder* the quantity of wind, which was 2827 cubic feet per minute of cold air, is now but 2120 cubic feet.

The furnaces of the Clyde have not been altered since the introduction of hot air. They had been in blast a long time when this new plan was adopted; one of them has been seven years in blast, and the regularity of its operations gives an earnest that it will last a long time.

At the commencement of this report, I have already stated the economy of fuel, and of flux, which had been obtained at the Clyde Works, by the introduction of hot air. I think it, nevertheless, useful to show the correctness of the estimate by transcribing a statement of the different expenses of manufacture during a month while cold air was used, and a corresponding month, with the use of hot air.

I make this statement from the books of the Works, to which I have been allowed access with a rare liberality.

*Consumption and Produce of three Furnaces, using Cold Air and Coke, during the month of February,* 1829.

| | Coke. | Ore. | Flux. | Pig Iron. | | | Castings. | Total. |
|---|---|---|---|---|---|---|---|---|
| | | | | No. 1. | No. 2. | No. 3. | | |
| | t. c. | t. c. | t. c. | t. c. | t. c. | t. c. | t. c. | t. c. |
| 1st week | 386 | 227 9 | 68 2 | 72 13 | 32 13 | 18 13 | 1 13 | 125 12 |
| 2d do. | 411 10 | 242 11 | 72 11 | 51 19 | 37 11 | 47 2 | 6 | 136 19 |
| 3d do. | 401 | 231 16 | 70 18 | 44 16 | 48 2 | 38 7 | 3 | 131 8 |
| 4th do. | 301 10 | 177 13 | 53 6 | 53 | 27 9 | 26 3 | 0 | 105 12 |
| | 1500 | 879 9 | 264 17 | 222 8 | 145 15 | 130 5 | 2 2 | 499 11 |

Add the consumption of the engine, averaging one ton of slack to the ton of iron made.

*Consumption and Produce of four Furnaces, using Hot Air and Coal, during the month of February,* 1833.

| | Crude Coal. | Ore. | Flux. | Pig Iron. | | | Castings. | Total. |
|---|---|---|---|---|---|---|---|---|
| | | | | No. 1. | No. 2. | No. 3. | | |
| | t. c. | t. c. | t. c. | t. c. | t. c. | t. c. | | t. c. |
| 1st week | 516 15 | 490 7 | 91 16 | 81 4 | 28 15 | 155 3 | " | 265 2 |
| 2d do. | 514 | 491 6 | 91 7 | 48 8 | 46 15 | 161 18 | " | 257 1 |
| 3d do. | 521 15 | 486 8 | 91 8 | 94 12 | 59 10 | 109 8 | " | 264 |
| 4th do. | 470 10 | 434 12 | 81 18 | 75 2 | 47 10 | 102 1 | " | 224 3 |
| | 2023 | 1902 13 | 356 9 | 299 6 | 182 10 | 528 10 | | 1010 6 |

The consumption of the steam engine averaged eleven cwt. per ton of iron produced.

The result of an examination of these tables is, that, for one ton of iron produced, there was consumed as follows:—

| 1829. *With Cold Air and Coke.* | | 1833. *Air heated to 612° Fahr. and Crude Coal.* | |
|---|---|---|---|
| 1. Coal for fusion— | t. cwt. | | t. cwt. |
| 3 tons of coke, corresponding to coal, . . . | 6 15 | Crude coal, . . . . . . . . . . . | 2 |
| Do. for steam engine, . . . . . . . . . | 1 | Do. for steam engine, . . . . . . . . | 11 |
| | | Do. for heating the air, . . . . . . . . | 8 |
| | 7 15 | | 2 19 |
| 2. Ore roasted, 3523 lbs., or . . . . . . . . | 1 15 | Ore, 3780 lbs., or . . . . . . . . . . | 1 18 |
| Its average yield being 57 per cent. | | Its average yield being 56 per cent. | |
| 3. Flux, 1056 lbs., or . . . . . . . . . . | 10¼ | Flux, 704 lbs., or . . . . . . . . . . | 7 |
| Daily production of furnace, 11,904 lbs., or about 6 tons. | | Daily production of furnace, 18,025 lbs., or about 9 tons. | |

* The steam engine which works the blowing apparatus, requires for fuel twenty tons of broken coal, or slack, per day of twenty-four hours, which costs one shilling and eight pence sterling per ton, (forty cents.)

The daily production having been raised at the Clyde Works from six to nine tons, the introduction of hot air has produced an economy in the consumption of fuel, and in the expense of manual labor.

The following shows the cost of manufacturing pig iron during these two periods:

| | In 1829. Cold Air. | | In 1833. Hot Air. | |
|---|---|---|---|---|
| | t. c. | d. c. | t. c. | d. c. |
| Coal for melting, at 5*s*. per ton, ($1 20,) . . | 6 13 | 8 98 | 2 | 2 40 |
| Do. for the blowing machine, at 1*s*. 8*d*. per ton, (40 cents,) . . | 2 | 80 | 11 | 22 |
| Do. for the heating apparatus, . . . . | | | 8 | 48 |
| Mineral roasted, at 12*s*. per ton, ($2 88,) . . | 1 15 | 5 04 | 1 18 | 5 47 |
| Flux, at 9*s*. per ton, ($2 16,) . . . . . . | 10 | 1 08 | 7 | 76 |
| Labor, at 10*s*. per ton, ($2 40,) . . . . | | 2 40 | | 1 60 |
| General expense, interest of capital, 6*s*., ($1 48,) | | 1 44 | | 96 |
| Total, . . . . | | 19 74 | | 11 89 |

*Note.*—The cost in sterling money is reduced to United States currency, at the rate of four dollars and eighty cents per pound.—[TRANS.]

### CALDER IRON WORKS.

These works are three miles from Glasgow, on the Edinburgh Road; the hot air blast has been used at them for three years past; two of the furnaces are fed by an apparatus like that at the Clyde Works, but at the other two the air is heated by means of a system of small tubes, represented in figures 6, 7, 8, and 9.

This apparatus is composed of two large horizontal tubes, *a c*, and *a' c'*, six feet long, nine inches in diameter in the clear, and one inch thick. Nine small tubes, six inches in diameter outside, and three inches inside, doubling upon each other like syphons, are placed vertically upon the pipes, *a c*, and *a' c'*, and fastened, by being driven tight into the throat, *d*. This system of tubes is placed in a rectangular furnace, ten feet long, three feet wide, and twelve or fifteen feet high. To prevent injury to the joints, care is

Fig. 6.

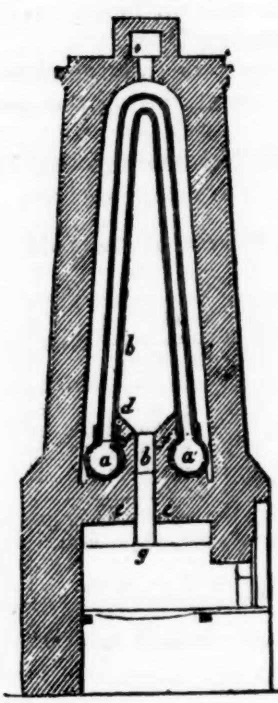


Fig. 7.

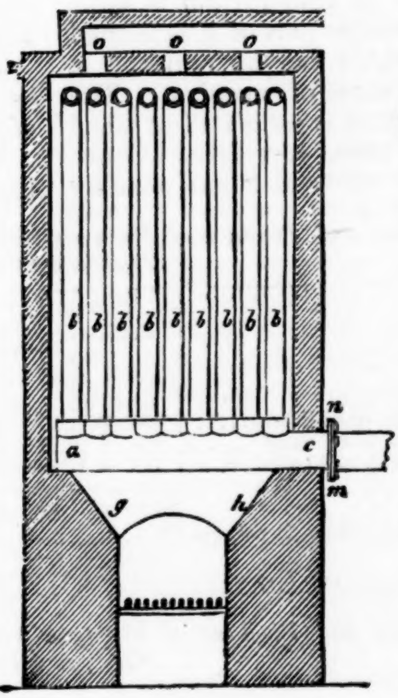
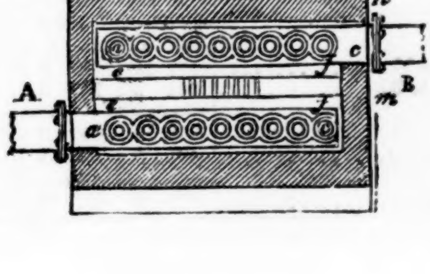


Fig. 8.

9



taken to protect them from the direct action of the fire. The joint, *m*, *n*, of the large pipes, is placed outside of the furnace, and the connexions of the small pipes with the large are shielded by fire brick. The flame is carried through the furnace by the longitudinal flue, *g*, *h*, passing the whole length; it is then spread among the tubes which it envelopes, gaining the chimney by the openings, *o*, *o*, *o*.

The temperature of the air is raised by this apparatus to 612° Fahr., as at the Clyde Works; the consumption of coal is 7 cwt. of coal per ton of iron produced.

This apparatus appears to be preferable to that of the Clyde. It takes less room; the bends in the small tubes, it is true, increase the friction of the air passing through them, but this circumstance appears to have but little influence on its motion. The power expended by the blowing engine is not greater than that at the Clyde Works, and the pressure of the air is two pounds and three quarters per square inch.

The expense of construction is quite small. The greatest part of it is formed of cast iron, which can be replaced at the works in case of accident. The cost of construction is estimated at about $150, requiring about seven tons of castings—say about one and a half tons for the large pipes, and five and a half tons for the small tubes. By estimating the iron cast into pipes, at $24 per ton, which is the average cost at the works using coal, the expense of each apparatus will be about as follows: Masonry, $100; earthen parts of the furnace, $60; casting pipes, $168; total, $328.

The expense will then be about $656 for each smelting furnace. At Calder they estimate the cost at about $168 to each tuyere. The apparatus at the Clyde is much more expensive; the quantity of iron required is seventeen or eighteen tons, and the masonry twelve times as much as at the Calder Works.

The working of the furnaces present the same circumstances as those of the Clyde, and it is useless to repeat them; but to exhibit the progress of the introduction of hot air, we shall indicate,

1. The consumption and products of the Calder Furnace, worked with cold air and coke.

2. The expenses and products of the same furnace, fed with air heated to 300° Fahr., also consuming coke.

3. The same results from the use of hot air and crude coal, during the month of July last.

The results which follow are extracted from the books of the establishment.

*Consumption and Produce of Furnace No. 3, in 1828, by the Use of the Cold Blast and of Coke.*

| | Coke. | Ore roasted. | Flux. | Cast Metal. No. 1. | Cast Metal. No. 2. | Cast Metal. No. 3. | Total. |
|---|---|---|---|---|---|---|---|
| | t. c. q. | t. c. q. | t. c. q. | t. c. | t. c. | t. c. | t. c. |
| From 6th Jan. to 3d Feb.......... | 550 2 0 | 276 8 0 | 105 3 1 | 95 4 | 39 1 | 20 3 | 154 8 |
| From 3d Feb. to 2d March........ | 545 1 0 | 274 5 0 | 101 0 1 | 100 1 | 34 2 | 18 2 | 152 5 |
| From 2d March to 30th do........ | 575 0 1 | 295 6 1 | 108 0 0 | 106 6 | 44 3 | 15 14 | 166 3 |
| | 1670 3 1 | 845 19 1 | 314 3 1 | 301 11 | 117 6 | 53 19 | 472 16 |
| Loss of Coal in coking, 55 per cent. | 2041 6 3 | 563 18 3 | Loss of Ore by roasting, 40 per cent. | | | | |
| Coal............................ | 3711 10 0 | 1409 18 0 | Ore, crude—pressure of air, 3¼ lbs. | | | | |

*Consumption and Produce of Furnace No. 3, in 1831. Air heated to 300° Fahr. and Coke.*

| | Coke. | Ore roasted. | Flux. | Metal. No. 1. | Metal. No. 2. | Metal. No. 3. | Total. |
|---|---|---|---|---|---|---|---|
| | t. c. | t. c. q. | t. c. q. | t. c. | t. c. | t. c. | t. c. |
| From Jan. 2 to 16................ | 189 12 | 120 3 0 | 52 10 1 | 57 11 | 11 0 | 42 2 | 110 13 |
| From Jan. 16 to 30................ | 204 3 | 130 6 | 64 7 0 | 46 7 | 0 0 | 27 0 | 73 7 |
| | 393 15 | 250 9 0 | 116 17 1 | 103 18 | 11 | 69 2 | 184 0 |
| Loss of Coal...................... | 481 5 | 166 19 1 | Loss of ore—pressure of air, 3 1-10 lbs. | | | | |
| Coal.............................. | 875 0 | 417 8 1 | Ore, crude. | | | | |

***Consumption and Produce of Furnace No. 3 during twelve weeks in 1832 and 1833, by Heated Air and Crude Coal.***

| | Coke. | | Ore roasted. | | | Flux. | | | Metal. No. 1. | | Metal. No. 2. | | Metal. No. 3. | | Total. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | t. | c. | t. | c. | q. | t. | c. | q. | t. | c. | t. | c. | t. | c. | t. | c. |
| From 4 Nov. to 2 Dec. 1833 ...... | 406 | 0 | 379 | 2 | 0 | 65 | 5 | 0 | 102 | 15 | 62 | 0 | 55 | 10 | 220 | 5 |
| From 24 Feb. to 23 March, 1833... | 458 | 8 | 389 | 6 | 1 | 64 | 7 | 1 | 116 | 10 | 31 | 0 | 52 | 10 | 200 | 0 |
| From 24 Mar. to 23 April, 1833.... | 476 | 4 | 427 | 14 | 1 | 53 | 19 | 1 | 121 | 10 | 36 | 10 | 62 | 0 | 220 | 0 |
| | 1340 | 12 | 1166 | 2 | 2 | 183 | 11 | 2 | 340 | 15 | 129 | 10 | 170 | 0 | 640 | 5 |
| Loss in Ore..................... | | | 797 | 8 | 0 | | | | | | | | | | | |
| Crude Ore....................... | | | 1993 | 10 | 2 | Pressure of air, 2¼ lbs. | | | | | | | | | | |

By comparing these tables, we learn that for one ton of iron produced, the furnace No. 3 consumed as follows:

1828. *Cold Air and Coke.*

| | t. | c. | q. |
|---|---|---|---|
| 7075 of coke, corresponding to 15724 lbs. coal, or.............................. | 7 | 17 | 0 |
| Ore roasted, 3792 lbs., or.......................... | 1 | 18 | 0 |
| Ore crude, 5970 lbs., or.......................... | 2 | 19 | 2 |
| Flux, 1330 lbs., or.............................. | | 13 | 0 |

1831. *Air heated to* 300° *Fahr. and Coke.*

| | t. | c. | q. |
|---|---|---|---|
| 4279 of coke, corresponding to 9510 lbs., or... | 4 | 15 | 0 |
| Fuel for heating the apparatus, valued at..... | | 6 | 0 |
| | 5 | 1 | 0 |
| Ore roasted, 2217 lbs., or.......................... | 1 | 7 | 0 |
| Ore crude, 4575 lbs., or.......................... | 2 | 6 | 0 |
| Flux, 1260 lbs., or.............................. | | 12 | 2 |

1833. *Air heated to* 612° *Fahr. and Coal.*

| | t. | c. | q. |
|---|---|---|---|
| Coal crude, 4187 lbs., or.......................... | 2 | 2 | 0 |
| Fuel for heating the apparatus, valued at..... | | 8 | 0 |
| | 2 | 10 | 0 |
| Ore roasted, 3735 lbs., or.......................... | 1 | 17 | 0 |
| Ore crude, 6228 lbs., or.......................... | 3 | 0 | 0 |
| Flux, 572 lbs., or.............................. | | 5 | 2 |

*Note.*—The consumption for the steam engine is not considered.

The furnace has produced each twenty-four hours,

| | | | t. | cwt. |
|---|---|---|---|---|
| 1828. | Metal, 11,238 lbs., or | ................... | 5 | 12¼ |
| 1831. | " 13,143 " or | ................... | 6 | 13 |
| 1833. | " 16,428 " or | ................... | 8 | 4¼ |

The consumption of combustion has, therefore, diminished from 7 t. 17 cwt. to 2 t. 2 cwt., and the amount of flux from 13 cwt. per ton of iron in 1828, to 5½ cwt. in 1833. This diminution must be charged to the increased temperature in the furnace by the use of heated air. I will indicate at the close of this Report, the reasons which appear to me to account for this increase of temperature, the existence of which is certain, though we have not been able to measure it.

The quantity of air blast has been reduced from 3500 cubic feet per minute, to 2627 feet, the pressure being reduced from 3¼ lbs. on the square inch, to 2¾ lbs.

The expense of the fuel for heating the air varies from 7 to 8 cwt. per ton of iron.

The consumption for the blast engine remains the same, but as the yield of the furnace has advanced from 5 tons 12 cwt., to 8 tons 4 cwt., the expense, divided on each ton of iron, is reduced from 1 ton 4 cwt., to 14 cwt.; the slack only is used for this purpose.

The consumption of ore has varied much, but, as the scoria never contains more than from .02 to .015 of iron, this difference depends on the quality of the ore, according as the *Ball ironstone* (mine eu rognous), or *flat ironstone* (mine eu couche), is used.

At Calder, as in the Clyde Works, the daily production of iron has been increased in a great proportion; this circumstance operates powerfully on the price of fabrication, as will be seen by the following statement.

***Cost of making one ton of Pig Iron at the Calder Works.***

| 1828. *Cold Air and Coke.* | | | | | 1833. *Air heated to 322° Fahr. and Crude Coal.* | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *t.* | *cwt.* | | *d.* | *c.* | *t.* | *cwt.* | | *d.* | *c.* |
| 7 | 17¼ | coal for fusion, at 4*s.* 6*d.* per ton......... | 8 | 50 | 2 | 2 | at 5*s.* per ton.............................. | 2 | 52 |
| 1 | 4 | coal for blast engine, at 1*s.* 8*d.* per ton... | | 48 | | 14 | at 1*s.* 8*d*.................................. | | 28 |
| 2 | 19¼ | crude ore, at 6*s.* per ton................. | 4 | 25 | | 8 | for heating apparatus, at 1*s.* 8*d*.......... | | 16 |
| | | Expense of roasting, at 10*s.* per ton...... | | 40 | 1 | 17 | ore roasted, at 12*s.* per ton.............. | 5 | 33 |
| | 13 | flux, at 7*s.* per ton....................... | 1 | 09 | | 5¼ | flux.......................................... | | 46 |
| | | Labor, at 10*s.* per ton.................... | 2 | 40 | | | Labor reduced in proportion to increase of yield.................................. | 1 | 62 |
| | | General expense, interest, &c........... | 1 | 44 | | | General expense, interest, &c.......... | 1 | 01 |
| | | | 18 | 76 | | | | 11 | 38 |

The blast engine employed at Calder is made with two cylinders, one over the other, with one shaft, so that the pistons of both are attached to the same beam, (*tige.*) The upper cylinder is fifty inches, and the lower cylinder seven feet, in diameter, each being seven feet long; the stroke of the piston, which is nine inches thick, is seven feet, and it makes sixteen strokes a minute.

MONKLAND IRON WORKS, NEAR AIRDRIE.

The heating apparatus used at this establishment is similar to that at Calder, being formed with two large pipes, and a number of small tubes, jointed in the large ones, the relative positions being changed.

The two large pipes, *a b*, *a' b'*, (figs. 4 and 5,) are vertical, and framed as shown in the plate. The small tubes, *c' c*, five feet long, which make the communication between them, are placed horizontal. This difference of position, and diminished length of the tubes, prevent the temperature of the air from being raised so high as at Clyde, or Calder.

At the time I visited Monkland, the air was heated to 450° Fahr., and coke was still in use for smelting.

The economy in fuel and flux obtained at these works, since the introduction of hot air, is nearly the same as at the Calder works, when the air at that furnace was heated to 300° Fahr., and coke still used in the furnace.

Fig. 4.

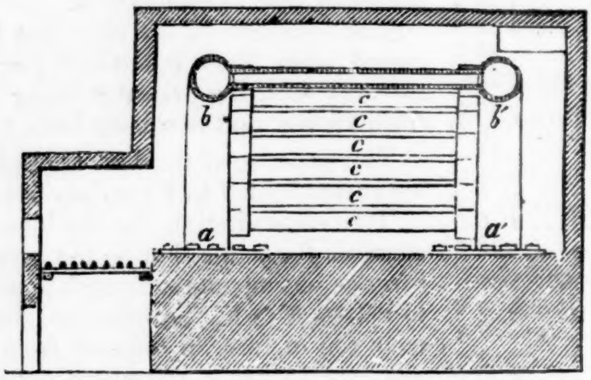
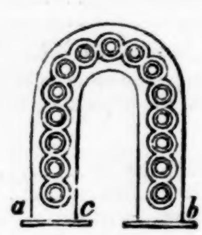



Fig. 5.




Before the adoption of the new plan, the Monkland works consumed from seven to eight tons of coal, for each ton of metal; since that time, there has been consumed 4 tons of coal for smelting; 6 cwt. of coal for hot air apparatus; 3 tons 5 cwt. crude ore; 10 cwt. flux.

The daily yield is now six tons; the pressure of the blast, two and three quarters of a pound.

The metal produced in the three works of which I have given the details, is, for the most part, intended for the foundry; the No. 3 iron alone is made into bar iron, and for this purpose is sold to the forges near Newcastle.

The pig metal, Nos. 1 and 2, though both destined for the foundries, are not employed indifferently.

The No. 1 iron is principally used for castings, which are to be worked as steam cylinders, &c., or for those requiring great strength. The No. 2 iron, though easily cut with a chisel, is nevertheless harder than the No. 1; it is employed, in preference, for cog wheels, and work requiring considerable hardness.

Besides the works of which I have treated, three others exist in Scotland, using the hot air blast; the results obtained in these establishments, by the adoption of the new plan, being similar to those cited, it appears useless to enter into details respecting them.

IRON WORKS IN THE ENVIRONS OF NEWCASTLE-ON-TYNE.

In the coal basin of Northumberland, the largest and richest in the kingdom, which furnishes almost all the fuel used in London, and the vicinity of the Thames, there are but two iron-works.

1st. The *Butterly Iron Works*, six miles from Newcastle, on the London road—the other called the *Tyne Iron Works*, on the banks of the Tyne, three miles from Newcastle. This region does not abound in good iron ore, and the proprietors have been unable, after the most minute search, to procure mineral enough

to supply these two works; but their position on the banks of the Tyne enables them, in spite of these unfavorable circumstances, to draw their supplies from Lancashire and Cornwall, at a cheaper rate than they can be obtained, for the most part, in our iron works.

Both these works have used the heated air for a year past.

The Butterly works, constructed but three years since, contain two furnaces forty-five feet high, four reverberatory furnaces, and several cupolas; all the iron made is intended for castings.

The results given by the apparatus for heating the air, are not sufficiently important to warrant a particular description and plate. The apparatus consists merely of a tube, returned five times upon itself at right angles, and disposed so that the cross section presents five circles, of which four have for the centres the angles of a rectangular parallelogram, and the fifth the point where the two diagonals intersect.

The tubes are placed horizontally, and are connected by bolts and nuts through lugs on the outside.

The interior diameter of these pipes is fourteen inches, and the metal one and a half inches thick; the length of the heated part is fifty feet, and the pipe is placed in a rectangular furnace, a little shorter than it, so that the joints and angles may not be exposed to the action of the fire.

The expenditure in fuel of this apparatus is about six hundred weight to the ton of iron produced. The pressure of the air is one and a half pound, being the same as before the introduction of the hot air. The velocity of the blast is a little less.

The charges of the furnace are as follows:

700 lbs. coke, (this coal gives 45 per cent. of coke;) 650 lbs. mineral roasted, being a mixture of equal parts of ore, (*minerai houiller,*) and the red oxide of iron from Lancashire; 400 lbs. flux.

From the register, it appears that there were made, in furnace No. 1, July 10, 40 charges; July 11, 42 ditto; July 12, 38 ditto; or an average of 40.

The same furnace produced, in these three days, 23 tons 11 cwt. of metal, or a daily average of 7 tons 17 cwt.

By taking this data, we find that, to make one ton of iron at Butterly, they consume 4 tons of coal for fusion; 6 cwt. coal in lumps to heat the air; 1 ton 13 cwt. ore roasted; 1 ton flux.

The quantity of flux employed is very considerable, because it is much charged with water, being a marly chalk, brought from the banks of the Thames by the coal ships.

The mixture of ore, when roasted, contains 60 per cent. of iron.

To appreciate the saving which has resulted at the Butterly works, from the use of hot air, it is necessary to know exactly the consumption for a ton of iron, before the introduction of the plan. I have not been able to procure documents which would furnish this; but Mr. J. Hunt, the manager, assured me that the expenditure was seven tons of coal.

If we compare these results with those obtained in Scotland, we shall find that the consumption at Butterly corresponds nearly with that at Calder in 1830, when the temperature of the air was raised to 300° Fahr. and coke was still burned.

At Newcastle, the price of coal forbids its use in the crude state, because the lumps, which are worth one dollar and forty cents the ton, must be used; while the slack, at forty cents, may be used to make coke for this purpose. It is nevertheless advantageous to give the air a higher temperature.

### TYNE IRON WORKS.

The consumptions of material in this work, for the production of a ton of metal, are nearly the same as at Butterly; but an important difference existing between these establishments is, that, at the Tyne works, a great portion of the pig metal is made into malleable iron. This iron, which is of a superior quality, is almost exclusively rolled into boiler plates. In the same furnaces, and with the same minerals, the two kinds of iron are made by varying the relative proportions of ore and coke.

Cupolas are also fed with heated air to great advantage, 225 pounds of coke being sufficient to melt a ton of metal.

The furnaces having been constructed since the adoption of the hot air plan, no comparisons in regard to economy could be instituted.

ENVIRONS OF MANCHESTER AND LIVERPOOL.

The *Rant* iron works, near Wrexham, in Flintshire—the *Apdale*, the *Laneend*, and the *Silverdale* works, near Newcastle-under-Line, Staffordshire—have adopted the hot air plan.

The apparatus used in these establishments are very like those represented at figures 7 and 8. At Apdale, precisely the same apparatus is used, and the results obtained since its introduction are almost identically the same as at Calder, the temperature of the air being raised to 600 or 612° Fahr.

The consumption of coal, formerly six tons to the ton of iron, is now reduced to three and a quarter tons. They still employ coke, the coal being sulphurous. The expense of the heating apparatus is 7 cwt. of coal to the ton of iron.

The quantity of flux is reduced in the same proportion. In July, when I visited Apdale, only one furnace was in blast, which had been five years at work, but only six months with heated air. Since that time, the yield of the furnace has been from six to seven tons per day; the iron produced being almost all No. 1; while before, the metal had been nearly equal parts of No. 2 and No. 3, the last being made into bar iron.

One work near Newcastle, belonging to Mr. Furnstone, has abandoned the use of the hot air blast. I should have endeavored to ascertain the cause of this, had I learned the fact in time to visit the works.

(*To be continued.*)

---

QUADRUPEDS OF MELVILLE ISLAND.—It will be recollected that this Island is near what is called in the Journal of the Royal Geographical Society, the Peninsula of Coburg—Northern Australia—a section of the world so comparatively new, that its productions are scarcely known. All the animals hitherto discovered there have been peculiar, and so unlike any thing in Europe, that naturalists are still looking with deep interest for further discoveries. Major Campbell, of the army, formerly commandant at Melville Island, has favored the learned with the results of his personal observations on its natural history. He remarks that the kangaroo, opossum, bandicoot, native dog, a small brown rat, a species of squirrel, and an animal very destructive to poultry, with a sharp nose and long brown hair, a tail 14 inches long, but bare, like a rat's, excepting within three inches of the tip, which is covered with long white hair, are the only quadrupeds. The animal measures 27 inches in length. Singular as it will appear, as yet it has no name. The flying fox or ternate bat, *vespertilio vampyrus*, is a wonderful creature. In flying, it looks nearly as large as a dog. By some means one of them was brought to Boston, and the wings, extended, measured near five feet from tip to tip. Major Campbell says several hundred of them fly at a time, and attach themselves to the limbs of trees. There are no other native quadrupeds yet detected. Birds are numerous beyond conception. Six varieties of pigeons, seven of paroquets, four of king-fishers, beside ducks, cranes, magpies, ravens, hawks, owls, water birds, &c., will convey some idea of their vast abundance in that beautiful country.—[Scientific Tracts.]

---

WEARING SPECTACLES.—Mr. Curtis, the celebrated oculist, in a recent publication, is very earnest in teaching the world, that when an individual feels obliged to wear glasses, for the first time, it is immensely important to future vision not to have the spectacle eyes too small. If, says Mr. Curtis, the glasses are not sufficiently large to cover the circle of the orbit, the wearer is obliged to look against the frame, as well as above and below it. The large, old fashioned spectacles, are therefore altogether superior to the modern article: oval bows he condemns in toto, as they exert a destructive influence over the organ, by obliging the whole muscular power of the eye to be exerted, in order to receive impressions through the very contracted window of the bow. He thinks highly of gauze spectacles, as screens to keep out the dust, so terribly destructive to vision in sandy regions and in cities, where the dust is whirled with tremendous violence through the streets, like blowing through so many tubes. He seems to be much opposed to operations on this delicately constructed organ.—[Ibid.]

# THE

# APPRENTICE'S COMPANION.

VOLUME I.] NEW-YORK, APRIL, 1835. [NUMBER 1.

MY object, in publishing this little work, is to be of service to those young men who are *now*, or may hereafter be, APPRENTICES; but who, in a few years, will be the active mechanics of the country.

My aim will be to give them a *just* idea of, and to teach them duly to appreciate their situation *as*, apprentices; and at the same time to point out the only *sure*, and honorable, way by which they may become good mechanics, respectable citizens, and highly esteemed members of society. A grand and leading object with me will be to impress upon them the importance of TEMPERANCE, INDUSTRY, FRUGALITY, and PERSEVERANCE; and in order to do it more forcibly, I shall illustrate their importance, by giving examples with which I am familiar; and incidents, as well from observation, as from history; and which will occur again, and again, as long as the relation of master and apprentice shall exist.

It is of great importance to a man, and especially a *young* man, when commencing a long journey, to know something of the road he is to travel. He cannot, indeed, be too well acquainted with its course, or with the difficulties to be encountered. So with the inexperienced youth, who leaves the parental, or guardian roof, or the pennyless orphan, when about to leave the asylum in which he found a shelter from the buffetings of a pitiless world—he ought to know something of the duties of the station he is designed to fill, before he enters upon it; as well as the best and surest mode of rendering himself contented, happy, and useful; and, at the same time, secure the confidence, good will, and affection, of those with whom he resides, and associates; thereby accomplishing two important objects at the same time, viz. the acquiring of a trade, or profession, and securing good friends, who may be willing to aid him into business, should he,—as most young men, who learn trades, do,—need it. It should be always distinctly borne in mind by young men, that a good character,—that is, an established character for *industry*, *frugality*, and *perseverance*, and, above all, for TEMPERANCE,—is better, far, than a capital without it; as with *such* a character he can obtain capital or credit at any time—whereas, without it, a capital would probably soon be squandered.

It is a mistaken idea, yet one generally entertained by boys, that men, *business* men, with whom they have no immediate intercourse, *take no notice of their conduct*. This is altogether a mistaken notion, and the parent, I have no doubt, of much mischief—or neglect of duty, and dissipation. In this matter I speak from experience—as I shall in many others—having been apprentice, journeyman, and master, and from having conversed upon the subject, both with the man of business and the apprentice, and think I cannot be mistaken. It will therefore be a leading object to convince those for whom this work is designed, that their conduct is always a subject of observation by, and frequently of *remark* among, men in stations far above them, and who have no direct interest in their welfare; and that *such* opinions of them, formed from their conduct, by such men, have a lasting influence upon their feelings towards them, for good, or for evil, in after life; and that it is, therefore, of the utmost importance to every apprentice, so to conduct as to have, not only the good will and confidence of his employers and immediate friends, but the respect of *every man* with whom he may become acquainted, or to whom he may be known, *even by sight*.

Another leading feature in the publication will be, to point out the evils of IN-temperance, especially upon mechanics; and some of the causes which bring this worst of afflictions upon innocent families; together with a view to guard the apprentice, if possible, against habits and practices so common—or were so, a few years since,—in many respectable shops, to wit, requiring every apprentice or journeyman to *treat the inmates, on entering or leaving a shop*—and frequently at other times, in the absence of the master,—from which practice a premature grave has been found by many a promising young man.

As much benefit may result from placing me-